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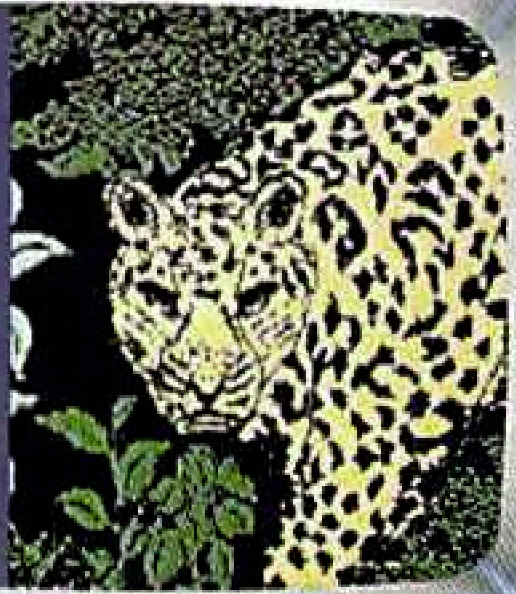


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ISSUE NO. 30 JUNE 1986

Ahoy! (#8750-4383) is published monthly by Ion International Inc., 45 W. 34th St., Suite 407, New York, NY, 10001. Subscription rate: 12 issues for $21.95, 24 issues for $41.75 (Canada $29.25 and $54.25 respectively). Second class postage paid at New York, NY 10001 and additional mailing offices.

No responsibility can be accepted for unsolicited material. Postmaster, send address changes to *Ahoy!*, 45 W. 34th Street, Suite 407, New York, NY 10001. Direct all address changes or matters concerning your subscription to *Ahoy!*, P.O. Box #341, Mt. Morris, IL 61054. All editorial inquiries and software and hardware to be reviewed should be sent to *Ahoy!*, 45 W. 34th St., Suite 407, New York, NY 10001.

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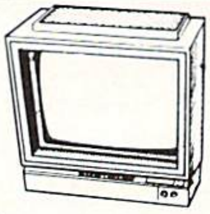
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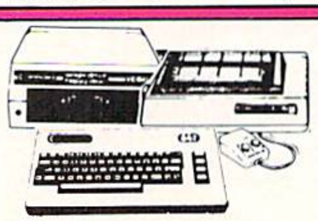
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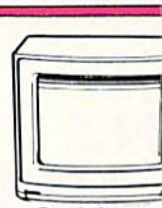


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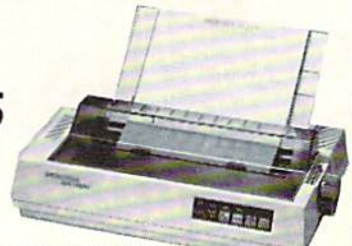
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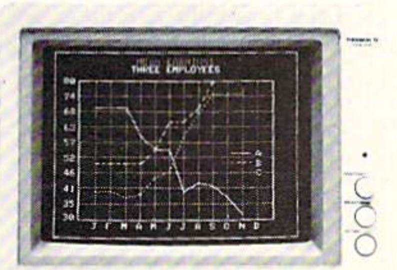
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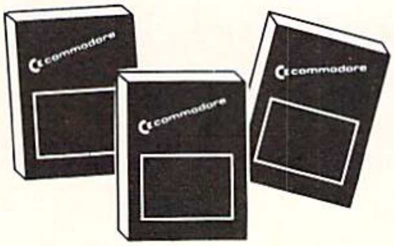
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VIEW FROM THE BRIDGE

We hate to waste space, as is evidenced by our custom of cramming every page of *Ahoy!* fuller than a Libyan lifeboat. But our monthly disks, alas, usually ship half empty. Not this month, though! The COMAL Users Group has allowed us to fill the disk space left over by our usual lineup of programs with some of their best short COMAL programs–including games, a graphics utility, a sprite animator, a turtle graphics tutor, and the operating system needed to run these and the programs included in COMAL's ads in each issue of *Ahoy!* In this way, Len Lindsay and his fellow apostles of the COMAL creed get to introduce you to their language, and you get more working programs for your money. Details on ordering the *Ahoy!* disk can be found on page 38.

As for the BASIC and ML programs found both on our monthly disk and in the magazine:

• Never have *Ahoy!'s* editors been so close to unanimous in agreement. But nearly everyone from the publisher to the guys at the disk duplication service agrees that *Star Strike* is the best all-around game ever to grace these pages! You'll understand why Bob Eaton took over a year to program this outer space arcade game. (Turn to page 34.)

• *Got A Match?* strikes that rare balance between entertainment and education, melding the two to the detriment of neither. (Turn to page 30.)

• An issue of *Ahoy!* without a Buck Childress utility? Don't even suggest it! *Trackdown* allows C-64 and VIC 20 users to automatically search their programs for any character or combination of characters. (Turn to page 80.)

• But Buck's position as *Ahoy!'s* ace utilitarian may be in danger! Michael Bennett's *LazyBASIC* is a shorthand program so useful that the most slothful among you will run, not shuffle to your 64's to type it in! (Turn to page 26.)

• There's no sense in losing your week's pay playing the old 'shell game' on the street corner ...not when *Shaker* will clean your clock for nothing! (Turn to page 45.)

• If chess baffles you, why not tackle the game a piece at a time? Like *The Knight's Tour* in November, *Queen's and Bishop's Tours* challenges you to cover the board with each piece, ending on the same square where you began. (Turn to page 41.)

• As always, we're more than just the best programs available on a magazine rack. Much of this month's "more" is provided, as usual, by Morton Kevelson, who has undertaken an ambitious introduction to Computer Aided Design (CAD) on the C-64, incorporating reviews of *CAD-PAK-64, Flexidraw 5.0, CAD GEM,* and *CAD-3D.* (Turn to page 57.)

• Dale Rupert eases C-128 users over potential *Debugging Dilemmas* with a rundown on the troubleshooting features incorporated into BASIC 7.0. (Turn to page 20.)

• Cheryl Peterson's *Cadet's Column* treats a topic of certain interest to beginners and experts alike–how to acquire public domain software. (Turn to page 77.)

• Included in this month's *Entertainment Software Section* is a guide to succeeding at one of the most popular series of games ever to perplex a C-64 owner: *Ultima.* Additionally, we provide an introduction to statistical baseball games, as well as reviews of *The Bard's Tale, Hero of the Golden Talisman, Quake Minus One, The Goonies,* and *Sword of Kadash.* (Turn to page 47.)

• Mark Andrews concludes his two-part *Commodore Roots* series on programming the SID chip in assembly language. Next month, the author of *C-64/128 Assembly Language Programming* (Howard W. Sams & Co.) shifts into C-128 mode! (Turn to page 67.)

Also inside is our *Art Gallery* of reader-rendered computer graphics; *Tips Ahoy!*, wherein we pick the brains of the best programmers and hardware hackers in our reading audience; *Commodares*, programming puzzlers known to drive many a man to drink; and more.

Next month will see the publication of the hardware portion of our long-awaited review of the Amiga (do we have to *tell* you by whom?). Line up at your newsstand early!

–David Allikas

SCUTTLEBUTT

DATA ENCRYPTER • DEVELOPMENT SYSTEM • DVORAK ROM • COLOR PRINTERS • GRAPHICS DISPLAY PANEL • BUFFER AND DATA SWITCH • AMIGA MEMORY EXPANDER • GAMES FROM ACTIVISION, SUBLOGIC, AVALON HILL • C-128 CHEATSHEETS • ASSEMBLER • DATABASE • COMMODORE REFINANCING

STILL AFLOAT

A happy postscript to April's *Scuttlebutt,* wherein we expressed our dubiousness concerning Commodore International's ability to remain in business long into 1986: the bank loans which the company came very close to defaulting on have been extended to the tune of $135 million. If that sounds like a fortune, remember that Commodore in 1985 put together several consecutive quarters of $90 million-plus losses. More record book mismanagement, combined with a continuing industry shakeout, could still scuttle the ship.

But we're not worried. Commodore's current management team, after all, managed to grub $135 million despite one of the worst track records in the modern history of American business. Such a management team, we feel, can do anything.

Now for the bad news: Commodore has sold off its liquid crystal display operation. This puts an end to whatever faint hope still existed of ever seeing the release of the LCD laptop computer announced concurrently with the 128—at least bearing a Commodore logo.

Commodore International, 215-431-9100 (see address list, page 82).

VIEWTRON CLOSES

Knight-Ridder Newspapers, parent company of the Viewtron bulletin board system frequently mentioned in these pages, announced on March 17 that the service would be permanently shut down within three weeks. The SYSOPs of Viewtron's Commodore SIG have asked us to inform users that the entire section may be absorbed by another bulletin board system. More details will be provided next issue.

Knight-Ridder Newspapers, Inc., 305-376-3838 (see address list, page 82).



The latest Cheatsheets *cover the Commodore 128, and several programs.*
READER SERVICE NO. 276

128 CHEATSHEETS

You knew that the increased surface area offered by the C-128 would be too much of a temptation for Leroy to resist. The first seven of *Leroy's Cheatsheets* for the Commodore 128 include *BASIC 7.0, Disk 1571, Easy Script, Fleet System 2 and 3, Paper Clip 128, WordPro 128,* and *Blanks* (set of three), with more to come. Each Cheatsheet is die-cut and plastic laminated, and includes a keyboard extender that makes it possible to use C-64 Cheatsheets as reference cards. Price is $7.95 each plus $1.00 shipping per order.

Cheatsheet Products Inc., 412-781-1551 (see address list, page 82).

DISPLAY PANEL

PSIDAC's Ani-Master Animated Graphics Display Panel ($119.95), an eight inch square LED display, plugs into the user port of the C-64 or C-128 to provide light show effects. Animated graphics and messages can be designed with a joystick. Pattern editing and saving features enable creations of sequences up to 30 minutes long. The display can be controlled from user-written programs with the included software. A 40-page user's guide provides examples.

Also available is a portable unit ($179.95) which can burn its pattern sequences into the panel and then display them (without a computer) by using batteries or an automobile cig-

arette lighter.

PSIDAC, 503-289-6254 (see address list, page 82).

ASSEMBLER

The *Rebel* assembler ($29.95) for both the C-64 and the C-128 allows total access to either computer's BASIC at all times while providing such extra facilities as a file lister, list freezer, and search and replace functions. In the 128's 80-column mode it provides an onscreen help menu and true split screen editing. The 64 version, because of BASIC 2.0's limitations, adds such options as renumber, page flipping, decimal to hex to ASCII conversions, and list scrolling.

Nu-Age Software, 813-323-8389 (see address list, page 82).

AMIGA MEMORY EXPANDER

A lower-priced alternative to the $195.00 Commodore-Amiga 1050 card memory expander, Starpoint Software's functionally identical 256K display RAM card ($120.00) installs in seconds behind the front panel, expanding available memory for programs and graphics to a full half megabyte. Standard system architecture is used to insure hardware and software compatibility. Included is a one-yeara warranty, manual, and schematics.

Starpoint Software, 916-842-6183 (see address list, page 82).

128 DATABASE

Data Master 128 ($29.95) allows users to develop multivolume data sets of up to 26,000 records, do searches, create mailing labels, and generate reports. Wild cards may be used within these conditions, increasing the program's search capability. An online help facility can be activated from any point in the program.

Bouncing Dog Software, 612-729-7662 (see address list, page 82).

AMIGA UTILITIES

Brown-Wagh has released three new productivity tools for the Amiga:

Modeled after *Lotus 1-2-3, Analyze!* ($99.95) takes advantage of the Amiga's special capabilities (pull-down menus, mouse, workbench, etc.) to produce spreadsheets up to 256 columns by 8156 rows.

The *OnLine!* ($69.95) telecommunications program comes equipped with user-definable macro keys that can be used to transmit often-used commands and script files for automated operation.

BBS-PC ($99.95), which turns an Amiga into an online information network, can interface to a hard disk and utilize a 2400 baud modem. The program will work in the background, answering the phone and taking messages while the computer is used for other purposes.

Brown-Wagh Publishing, 408-395-3838 (see address list, page 82).

COPY PROGRAM

Super Kit/1541 claims a normal copy time of 32.68 seconds and a nibble copy time of 34.92 seconds per disk. Included is a track and sector editor providing full editing in hex, decimal, ASCII, and binary, a monitor/disassembler with printout commands, and a sector by sector GCR editor with bit density scan. Price is $29.95 plus $3.00 shipping.

Prism Software, 817-757-4031 (see address list, page 82).

DATA ENCRYPTION

PCSecure ($49.50) provides Commodore 128 users with data file protection via a key-driven code. You encode a file by typing a key, then decode it the same way. Multistage encryption provides further security by preventing nonauthorized users who are as close as one digit away from cracking the encryption password from knowing how well they're doing.

SourceView Software International, 415-228-6220 (see address list, page 82).

CLINICAL INTERVIEWER

Written by a professor of psychology, the *Clinical Interview* series allows members of the helping professions to develop their skills in interviewing patients or clients. The first disk in the series, *The Mental Health Setting*, portrays five patients who tell their stories while the interviewer practices using active listening skills and asking appropriate questions.



The Juki 5510-Color provides 96 italic characters and 11 international character sets. *READER SERVICE NO. 261*

The next release, *The General Hospital Setting,* will be of primary interest to students of nursing, physical therapy, and other hospital-based helping professions.

Clinical Interviews, 607-869-5955 (see address list, page 82).

DEVELOPMENT SYSTEM

The *Total Software Development System (TSDS)* consists of a macro assembler and editor, sprite editor, matte and character set editor, and sound effects editor. 38 new commands are provided for simplifying disk operations and other functions.

NoSync Development Corp., 604-464-2983 (see address list, page 82).

SPRITE EDITOR

Though it may sound like an alternative title for a certain Oscar-winning movie, *MOB Master II* ($12.00) is actually a sprite editor which allows the C-64 user to draw hi-res or multicolor sprites with a joystick, move or expand them horizontally and vertically, reverse and clear single sprites or entire sections of memory, select colors, incorporate sprites into programs, and take memory snapshots.

Tidal Bore Software (see address list, page 82).

C-128 TRANSLATIONS

Free Spirit Software has updated two C-64 programs to operate on the C-128:

BASICally Simple 128 ($19.95) provides instruction in BASIC programming, including the additional commands available on the C-128.

The *Postmaster128* ($9.95) mailing list program can be used to store, retrieve, and sort names, addresses, zip codes, and phone numbers.

Free Spirit Software, Inc., 312-476-3640 (see address list, page 82).

COLOR PRINTER NEWS

The Juki 5510-Color is their standard 5510 dot matrix printer with the available color option already installed, enabling the user to produce seven colors from a four color ribbon. Maximum speeds are 180 characters per second in draft mode and 30 in near letter quality. Price is under $650.

Juki Office Machine Corp., 800-325-6134; in CA 800-435-6315 (see address list, page 82).

For three months beginning March 30 and ending June 30, 1986, purchasers of the Okimate 10 printer will receive a $15 cash rebate from the manufacturer. It will be necessary to complete and return to Okidata a rebate coupon, available where the printers are sold or by calling 1-800-OKIDATA.

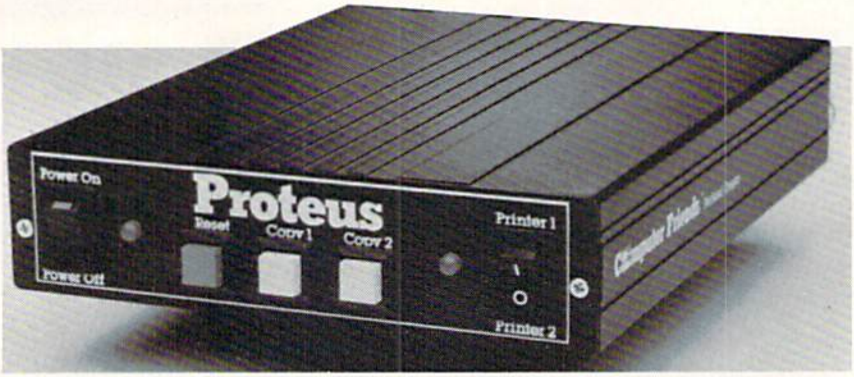
Okidata, 609-235-2600 (see address list, page 82).

LISZT THESE

The first release in Tidal Bore's *Miniature Melodies* series for the C-128, *32 Catchy Classics* ($12) contains 32 classical music selections by Bach, Beethoven, Handel, Schumann, and others that can be listened to or incorporated into user-written programs.

Tidal Bore Software, 902-895-4563 (see address list, page 82).

Music of the Masters ($9.95) contains over 20 works by Mozart, Bach, Beethoven, and others, totaling about 45 minutes of listening. Onscreen commentary is provided for each composer as his music is played.



Proteus buffer/data switch: connect two peripherals to any computer.
READER SERVICE NO. 272

Free Spirit Software, Inc., 312-476-3640 (see address list, page 82).

AMIGA MASTERTYPE

The new Amiga version of *MasterType* ($39.95), available for the 64 for three years, features graphically enhanced finger positioning charts, more sentence typing practice, and rhythm instruction at a greater range of speed. Also included are new lessons on numbers, symbols, and numeric keypad, and common programming terms.

Scarborough Systems, Inc., 914-332-4545 (see address list, page 82).

ARITHMETIC QUIZ

Math Pop Quiz ($19.95) for the C-64 teaches arithmetic to learners at various levels. Correct, prompt answers earn points and darts for popping balloons. The program automatically allows more response time for those who need practice and trims it for kids scoring 80% or better.

SourceView Software International, 415-228-6220 (see address list, page 82).

DISK LIBRARY PROGRAM

Disk Library will allow the Amiga user to list, catalog, and cross reference every file on every disk in his collection. It will also search for files and update itself automatically. Space is provided for comments and remarks. Price is under $50.

Classic Image, Inc., 201-389-3633 (see address list, page 82).

BUFFER/DATA SWITCH

The *Proteus* double buffer and data switch contains two parallel ports, making it possible to connect two printers or other parallel peripherals to any computer. Possible applications include running drafts on one dot matrix printer and final copies on a letter quality printer, or loading one printer with letter size paper and the other with labels for mail merge operations. The two buffers have flexible capacity, meaning that each is automatically allocated as much memory as is available, up to the buffer's maximum capacity. Price is $199 for the 64K version and $299 for the 256K version.

Computer Friends, 503-297-2321 (see address list, page 82).

MW-350 UPDATE

The MW-350 MicroGrafix Parallel Printer Interface reviewed in the February '85 *Ahoy!* has had its operating system revised to better accommodate the specific needs of the C-128 in CP/M mode, with the addition of an ASCII translation mode in which only the printable Commodore text characters are converted to standard ASCII and all other printer control codes pass through the interface unchanged. More details will be provided in next month's full-length review.

Also newly available from Micro R & D is the Model MW-401 C-128 Cable, which adapts the computer's three composite outlets into one outlet at the flip of a switch. Three modes are 40 column color, 40 column monochrome, and 80 column monochrome. A sound output is also provided.

Micro R & D, Inc., 303-985-4077 (see address list, page 82).

FREE HEAD CLEANER KIT

3M is including a free head cleaning diskette and three packets of cleaning solution with specially marked packages of 5¼" diskettes. Also included is a $2 rebate form for 3M's regular head cleaning kit.

3M, 612-736-2335 (see address list, page 82).

CHECKBOOK PROGRAM

PC Home Checkbook ($39.95) lets C-64 owners keep track of their checking accounts by week, month, or year. Four basic types of transactions can be recorded and edited: checks written, deposits, automated teller activity, and bank charges. Space is provided for each transaction's check number, date, amount, tax-deductible status, recipient, purpose, and expense category. Up to 20 expense categories can be created. A statement can be provided covering all transactions within a certain category or a certain time period.

SourceView Software International, 415-228-6220 (see address list, page 82).

PARTNER 128

Partner 128 ($59.95), a collection of desktop organization programs, is designed to operate concurrently with other C-128 software. Included are a business calculator, memo pad, appointment calculator, address and phone books, envelope addresser, a one-key screen dump, and a "typewriter" program that simplifies small typing jobs like labels and forms.

Timeworks, 312-948-9200 (see address list, page 82).

BOOKS

Practical Interfacing Projects with the Commodore Computers supplies hardware and software information for turning a Commodore into a controller for science, engineering, or home and hobby electronic applications. Over 80 programs are provided, as well as an introduction to using machine language for controlling I/O projects. Among the projects included are a digital to analog convertor circuit for the user port of the VIC, 64, or 128, a waveform recording system, and an I/O system for the Plus/4 or C-16 utilizing a card cage method. Price is $16.45 paperback, $24.95 hardbound.

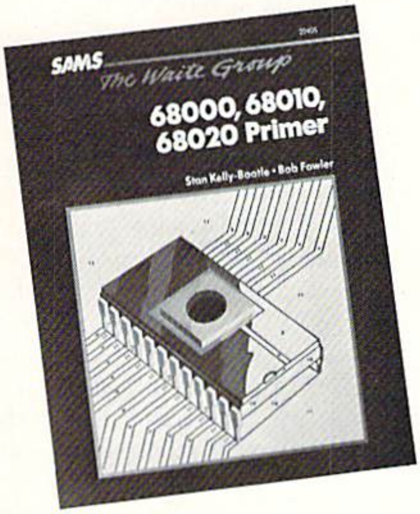
Tab Books Inc., 717-794-2191 (see address list, page 82).

The One-Hour Commodore 64 ($5.95) guides the user through his first 60 minutes with the computer, covering setup, the keyboard, loading and saving programs on cassette or disk, sound, and printer use. The 128-page paperback includes a bibliography and glossary.

InfoBooks, 213-470-6786 (see address list, page 82).

Howard W. Sams & Co. will add volumes covering the Commodore 128, the 1571, and the 1984 version of the C-64 to its line of Computerfacts manuals, each containing standard notation schematics created by a computer-aided design system, reproductions of waveform photos, preliminary service checks, troubleshooting tips, replacement parts lists, and semiconductor cross-references. Previously released volumes cover the C-16, VIC 20 (early and later versions), Plus/4, 64, 1525, 1541, and 1701. Prices range from $19.95 to $39.95.

Also new from Sams is *88000, 68010, 68020 Primer* ($21.95), an introduction for novice or experienced programmers to the instruction set and addressing modes common to the 68000 family. Included is information



For novice or expert programmers. READER SERVICE NO. 273

on the architecture of the chips, programming in assembly language, code mapping, how to use various instructions and registers, and uses of the chips in multiuser systems.

Finally from Sams, the *Commodore 1541 Troubleshooting & Repair Guide* ($19.95) provides schematics, step-by-step troubleshooting flow charts, disassembly/reassembly instructions, callibration and alignment procedures, block diagrams, parts layouts, and mechanical and electrical theory of operation.

Howard W. Sams & Co., 317-298-5400 (see address list, page 82).

The Mystical Machine: Issues and Ideas in Computing ($21.95), in addition to providing an introduction to programming and computer architecture, considers the computer in terms of its social ramifications, its potential benefit or danger to mankind, and possible applications.

Addison-Wesley Publishing Company, 617-944-3700 (see address list, page 82).







Schematics, flow charts, layouts, etc.
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DVORAK ROM KIT

Produced under license from Commodore, Prelco's *DV Switcher* ROM kernal kit allows C-64 users to shuttle back and forth between standard QWERTY and Dvorak keyboard layouts. Included is a modified ROM kernal, a switch to allow selection of the new ROM or original QWERTY ROM, and key covers with Dvorak and QWERTY markings. The $39.95 price does not include cost of installation by a competent technician.

Also available from Prelco is the *DV Typer* Dvorak typing tutor for the 64 and 128.

Prelco, 714-544-3041 (see address list, page 82).

GAMES

For the past 12-18 months, Activision's output in the adventure game field has steadily increased while that of the longtime leader, Infocom, has dwindled down to almost nothing. Still, in the best John D. Rockefeller tradition, Activision has insured an even larger market share in the future by purchasing Infocom, exchanging 2 million shares of Activision common stock for all outstanding shares of Infocom stock. The total transaction was valued at approximately $7.5 million. Infocom devotees will be pleased to know that Infocom will retain its own product development and marketing operations in Cambridge.

The first installment in Activision/Gamestar's *Championship Golf: The Great Courses of the World* series, titled *Volume One: Pebble Beach*, will see release this fall for the C-128 and Amiga. The game (not to be confused with Sportsware's *Championship Golf at Pebble Beach*, announced in last month's *Scuttlebutt*) recreates an actual course layout down to sand traps, roughs, and trees. Up to four players can view all 18 holes from multiple perspectives, as well as control club selection, stance, and type of swing for each shot. A caddy will suggest a club for any shot should a player request assistance.

Activision, Inc., 415-960-0410 (see address list, page 82).

Previously available for Apple, IBM, and the C-128, the *Gato* submarine simulation has been released in a scaled-down version for the C-64 that includes 8 missions, 5 difficulty levels, and 3 ships. The player's job as captain of a World War II "Gato" class submarine is to avoid using sunk by an enemy that is programmed to think strategically. Price is $29.95.

Spectrum HoloByte, Inc., 303-444-7737 (see address list, page 82).

The Great War ($19.95) for the C-128 maneuvers several hundred units of infantry, cavalry, and artillery, representing the armies of 16 nations, over a map of 1914 Europe. The player's military strategy must take into account terrain, political considerations, troop strength, weaponry, supply lines, and weather as he commands either the Central Powers or the Allies against the computer or another player.

Free Spirit Software, Inc., 312-476-3640 (see address list, page 82).

SubLOGIC's *Football* for the C-64 is intended as a physical rather than a statistical simulation of the sport. One or two players direct offense and defense, choosing their quarterbacks, receivers, and running backs and taking into account weight, speed, and abilities. The movement of 22 players is simulated in a 3-D perspective.

SubLOGIC Corporation, 217-359-8482 (see address list, page 82).

Four new C-64 releases from Avalon Hill:

Spitfire '40 ($35.00) recreates the experience of piloting a Mark I Supermarine Spitfire, right down to the

Continued on page 106

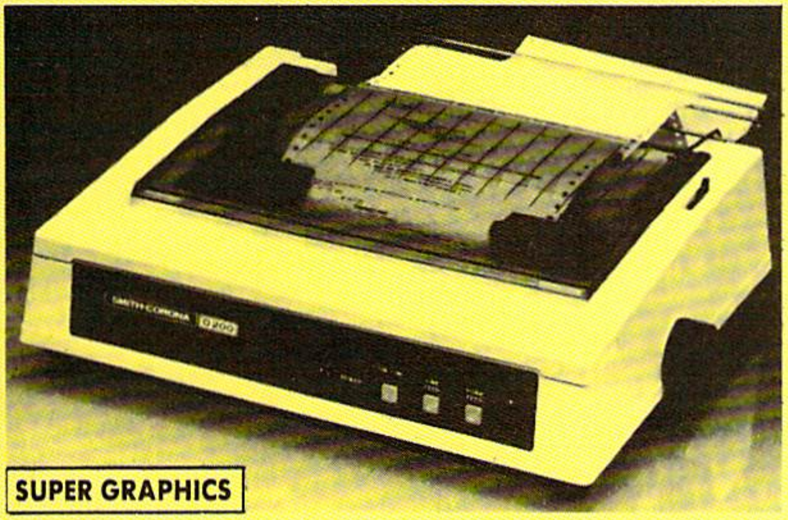
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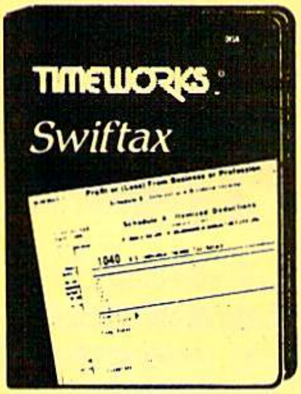
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DEBUGGING

EASING THOSE TROUBLESHOOTING TRIBULATIONS

Eliminating the bugs in a BASIC program can certainly be a frustrating experience. The debugging tools built into BASIC on the VIC 20 and C-64 are minimal at best. Among the many virtues of BASIC 7.0 on the Commodore 128 is a powerful collection of features to help with program development and troubleshooting.

This month we will discuss various commands and techniques which are helpful for tracking down and eliminating program faults on the C-128. They may not make the task of debugging enjoyable, but these methods should at least ease the burden of eradicating *Insectus programma* (pardon the Latin).

One of the major advantages of the BASIC language, besides its ease of being learned, is its interactive nature. BASIC provides a programming environment which allows the programmer to write, run, modify, and rerun a program without leaving BASIC. Someone who deals with compiled languages such as FORTRAN, C, and PASCAL generally pays the price of cumbersome "environment swapping" and a lack of immediacy.

A program written in a compiled language is generally created on an editor, which may be similar to BASIC's screen editor. The program source file, as it is called, must be compiled to create the object file. Typically the object file must be massaged and merged with various library files by sending it through a "linker" program. Then the program is in a form to be executed. If it doesn't run properly, the entire process of editing, compiling, linking, and executing must be repeated.

In contrast, the cycle for an interpreted language such as BASIC is simply edit and execute. If it doesn't run correctly, edit it and run it again. Execution speed is one of the main disadvantages of using an interpreted language. Ease of making changes and testing them is one of the main assets.

Even though a BASIC program can be quickly modified and rerun, knowing what to modify can be difficult if the particular implementation of BASIC provides only limited debugging tools. BASIC 2.0 on the C-64 is very limited. Various utilities have been written and published which simplify the analysis and troubleshooting of C-64 programs. Unfortunately the use of a separate program for debugging greatly reduces the interactive nature of the language and thereby diminishes one of its advantages.

WITHOUT A TRACE

An essential part of program development is being able to follow the program's execution line by line. On the C-64 the programmer typically places STOP statements at strategic places throughout the program in order to know when certain statements are being executed. The computer stops execution and responds "BREAK IN 20"



DILEMMAS

BY DALE RUPERT

when a STOP statement in line 20 is reached. The programmer may then type CONT, and the program will continue up to the next STOP statement. There is no convenient way to trace the program flow.

The C-128 provides a "trace" mode of operation in which the currently executed line number is displayed on the screen as the program is run. To follow the entire program sequence, we may type TRON (meaning "trace mode on") before typing RUN. The line number of each executed statement is displayed in square brackets. The line number is repeated if there is more than one statement on the line. The TROFF statement disables the trace mode.

It is frequently desirable to trace only portions of a program. We may add TRON and TROFF statements to the program surrounding those portions. For example, enter this program:

```
10 GET A$ : IF A$="" THEN 10
20 IF A$="Y" THEN A$="YES"
30 PRINT A$
40 GOTO 10
```

Type TRON then type RUN. The screen is quickly filled with [10]'s as the program loops at line 10. Whenever a key is pressed, lines 20, 30, and 40 are executed. To trace only the interesting parts of this program, add these lines:

```
15 TRON
35 TROFF
```

then type TROFF and RUN. Now the trace function is selectively enabled and disabled. This is obviously a trivial example. (A better program would use the GETKEY A$ statement in line 10, anyway.) But the ability to turn the trace on and off within a program is clearly very useful.

Keep in mind that the NoScroll key will freeze the display and allow you to study the trace output on the screen. It may also be easier to follow the program with the computer in the SLOW mode rather than in the FAST mode. Simply type SLOW or FAST before running. Occasionally we might add the SLOW and FAST statements to the program itself to give a better handle on what the program is doing.

One final feature of the trace mode is that the trace can be sent to the printer or to a disk file, if desired, rather than to the screen. Replace lines 15 and 35 above and add line 5 as follows:

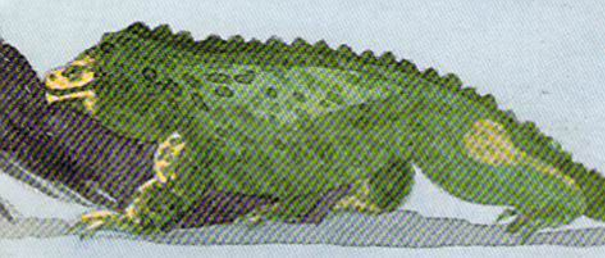
```
5 OPEN 4,4
15 CMD 4
35 REM
```

Then type TRON and RUN. The program lines between the CMD and the GET statement will be sent to the printer. Evidently the GET statement disables the CMD statement so the traces of line 10 are still displayed on the screen. That is why the CMD command must be executed after every GET or GETKEY statement. Press the RUN/STOP key to stop the program.

To send the trace output to a disk file, change line 5 to

```
5 DOPEN#4,"@TRACEFILE",W
```





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The "@" allows the file to be rewritten. The CMD 4 command in line 15 causes the trace output to be stored in a sequential disk file called "TRACEFILE". Again type TRON and RUN, then press various keys. Press the RUN/STOP key to stop execution. Finally type PRINT#4 : DCLOSE to close the file.

To display this sequential file once it has been created, add this simple three-line routine:

```
100 DOPEN#4,"TRACEFILE",R
110 DO WHILE ST=0 : GET#4,A$ : PRINT A$;
 : LOOP
120 DCLOSE : END
```

Type TROFF then RUN 100 to display the trace file.

MORE BASIC HELP

Another nice feature of BASIC 7.0 is the HELP command. When the interpreter runs into a syntax error or any other error, execution is halted and a message describing the error and the line number is displayed. Normally we would LIST the offending line, identify the problem, and edit the program.

If the fault occurred in a multistatement line, it may not be obvious as to which statement created the error. Pressing the HELP key on the C-128 (or typing HELP) causes the line containing the error to be listed. Furthermore the faulty statement and all succeeding statements on the line are underlined (in 80 column mode) or highlighted (in 40 column mode).

The line may be conveniently corrected and entered, and the program may be rerun. Keep in mind that an error identified in a READ statement may actually be in the associated DATA statement.

Don't forget that the current values of all variables are retained in memory even if an error occurs. Typing PRINT X in direct mode will show the value of the variable X when the program stopped. On the C-64 and VIC 20, be sure NOT to make any changes to the program, however, until you have displayed the values of any relevant variables. Once a line has been edited or a new line has been added on those computers, the values of all variables are lost. More on that in a moment.

One more useful technique is to change the value of a variable in direct mode and to restart the program from some strategic location. The only catch is that you must use the GOTO statement, *not* the RUN statement. For example, type

```
X=2 : GOTO 20
```

to change the value of X and to continue execution at line 20. This works even if the program was halted because of an error. If you type RUN 20, the values of all variables are reset to zero or the null string before execution starts at line 20.

Type this example:

```
10 X = 5 : A$ = "HELLO"
20 PRINT X : PLINT A$ :REM NOTE TYPO ERR
OR
30 PRINT X,A$
```

Type RUN and you will see the value of X followed by ?SYNTAX ERROR IN 20. Press the HELP key to list line 20 with the PLINT and REM statements underlined or highlighted.

If you now enter PRINT A$ in direct mode, its value is displayed. Enter GOTO 30 and you will see that X and A$ still have their proper values.

At this point, the C-128 and the C-64 part company. If you change, add, or delete any lines on the C-64 (or VIC 20), all variables are automatically reset. Change the PLINT to PRINT in line 20 then type GOTO 30. On the C-64, the values of X and A$ are 0 and the null string respectively. On the C-128, X and A$ still retain their last assigned values.

The C-128 has a memory space for the program which is separate from the storage areas for the variables. On the C-64, numeric variables are stored in the memory locations immediately following the program. Any changes to the program could overwrite the variable storage area. Therefore the C-64 simply clears all variables whenever the program is edited. In the C-128, the program cannot infringe upon the variable storage area, hence there is no need to clear the variables after editing.

MONITORING BASIC

The final aspect of debugging and troubleshooting we shall discuss deals with the internal storage of the BASIC program and its variables. Let's look at some of the ways that the C-128's built-in monitor can help analyze the inner workings of our programs.

One of the most frustrating problems to debug involves the internal round-off of variables. For example, this program prints two 5's on the screen but tells us that they are not equal:

```
10 XA=5 : YB=SQR(25)
20 PRINT "XA =" XA
30 PRINT "YB =" YB
40 IF XA <> YB THEN PRINT "XA DOES NOT E
QUAL YB"
```

In the April 1984 *Rupert Report* we discussed this problem in detail. We used BASIC routines to look at the internal storage of variables. With the C-128's monitor and the POINTER function, we can investigate the storage of variables much more easily.

Add this line to the program above, then RUN it again.

```
50 PRINT HEX$(POINTER(XA)),HEX$(POINTER(
YB))
```

The hexadecimal values 0402 and 0409 are displayed. These numbers represent the memory locations in BANK

1 where the values of XA and YB begin.

Enter the MONITOR by pressing SHIFT-f8 or by typing MONITOR. Type M 10400 1040F. Sixteen memory locations beginning at address 10400 are displayed. The leading 1 in the address represents the BANK number. The numeric display looks like this:

```
>10400 58 41 83 20 00 00 00 59 42 83 20
00 00 01
```

where the last two pairs of digits are irrelevant. The 58 41 corresponds to the hexadecimal (hex) values of the characters "XA". ("X" is CHR$(88), and 58 is the hex equivalent of decimal 88. Refer to Appendix E of the *C-128 System Guide* for the ASCII character values in decimal.)

The right side of the screen displays the ASCII characters XA and YB as well as dots for the unprintable characters. We saw that HEX$(POINTER(XA)) gave a value of 0402. The five bytes beginning at 10402 are the internal representation of the value of XA: 83 20 00 00 00. The five bytes beginning at 10409 correspond to the value of YB: 83 20 00 00 01. Clearly XA is stored differently from YB, although both of them are displayed as "5" on the screen.

To see the power the monitor gives us, move the cursor over to the 01 and change it to 00 and then press RETURN. Next type X and RETURN to exit from the monitor. At the READY prompt, enter GOTO 20. Lo and behold, the PRINT statement in line 40 is bypassed! We have modified the stored value of YB so that XA does equal YB.

If you like to explore, make other changes to the stored values with the monitor. Back in BASIC, PRINT the changed variable. For example, change the 83 to 84 at location 10402. In BASIC, type PRINT XA. XA now has the value 10.

Changing variable values with the monitor is not generally useful in troubleshooting. The monitor is more likely to be used just to see how different variables are stored. In the examples above, XA and YB are floating point variables. The storage formats for variables other than floating point variables are different from this.

For example, type NEW then enter the following program:

```
10 XA$="HELLO": PRINT HEX$(POINTER(XA$))
20 XA%=32767   : PRINT HEX$(POINTER(XA%))
30 XA%(2)=32767: PRINT HEX$(POINTER(XA%(
2)))
40 XA=5 : PRINT HEX$(POINTER(XA))
```

RUN the program. The four pointers printed are 0402, 0409, 0419, and 0410. Now enter the monitor. Type M 10400 10420 to see the internal storage of these four variables. The variable type is encoded in the variable name. For example, XA$ is shown as "58 C1" in locations 10400 and 10401. If the second character has a value greater than $80 (hexadecimal 80), it is known to be a string variable. If both the first and second characters have values greater than $80, the variable is an integer.

The variable name XA% is stored as "D8 C1" starting at location 10407. Subtracting $80 from each of these numbers gives "58 41" which corresponds to the characters "XA" that we saw above. The value of XA% is 32767 which is $7FFF in hexadecimal. The two bytes $7F and $FF are shown starting at location 10409, agreeing with the POINTER value printed earlier.

The string variable XA$ begins at 10400. The first two bytes "58 C1" are the encoded variable name. The next byte "05" is the length of the string. The next two bytes "F9 FE" form a pointer to the actual storage location. These bytes are in reverse order from the way they must be typed following the M command. Type M 1FEF9 to see the value of the string. At the right side of the display are the characters "HELLO".

Array variables are stored after the scalar string and numeric variables. The first bytes of XA%( ) are as follows:

```
D8 C1 1D 00 01 00 0B 00 00 00 00 7F FF
```

The variable name "D8 C1" is encoded the same as for other integer variables. The next two bytes "1D 00" indicate the total number of bytes used by this variable, namely $001D or 29. The next byte "01" specifies the number of dimensions in the array. The next two bytes "0B 00" tell that there are $000B, or 11, elements in that one dimension, namely XA%(0) through XA%(10). A DIM statement must be used to allocate more or fewer than eleven elements per dimension.

There are two pairs of "00 00" corresponding to XA%(0) and XA%(1). XA%(2) is stored as "7F FF" which is $7FFF or 32767. In a similar manner, the enthusiastic reader may investigate the storage of arrays with more than one dimension.

There is one other set of diagnostic tools built into BASIC 7.0, the TRAP/RESUME statements and the error message variables. These features can be helpful during troubleshooting and debugging. Their primary use is for making a program foolproof, even when the program is run by an inexperienced operator. We will discuss these concepts in a future column. □

ERRATA

Air Rescue, Hidden Cavern (April)

It may have seemed like a cruel April Fool's joke, but the only fools were we, for omitting portions of the abovenamed programs during printing. Call or write us to receive the missing sections (too lengthy to print) by return mail.

Comet Catcher (April)

Bitmapper's routine for drawing the sun was missing one line. Insert the following:

```
50 GOSUB 2000
```

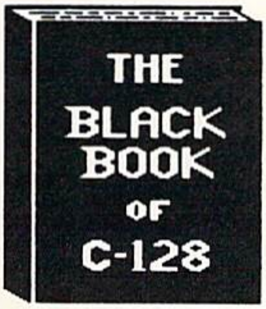
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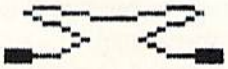
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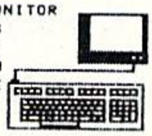
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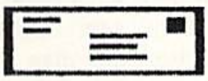
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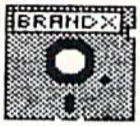
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LAZYBASIC

Painless Program Entry for Basically 'Shiftless' Typists

By Michael Bennett

This may be the most user-friendly BASIC shorthand program you have ever seen, with many additional features that make it a painless way to enter BASIC programs.

I am a very lazy typist, and the keyboard symbols that require the most work are the ones which can only be accessed by holding down a SHIFT key and stretching your finger. *LazyBASIC* changes that for some of the most useful symbols in BASIC programming, such as the parenthesis and the $ sign. Instead, you access them by hitting one of the shiftless function keys, fl through f7, and then (at your leisure) hitting one of the letter keys. In the same way you are allowed two-stroke access to all the BASIC keywords that are longer than two letters (since two strokes doesn't save you any time with those). The only exception to this rule is CONT, which is left out because it is never used in program mode.

Unlike other shorthand programs, *LazyBASIC* doesn't force you to memorize which keys to hit. It provides you with an onscreen menu that is refreshed every time you hit the RETURN key. The BASIC keywords are listed alphabetically in columns that are headed by the function key you must hit prior to hitting the letters (A-Q) which correspond to the keyword you want.

Since the menu covers the top three quarters of the screen, your writing takes place on the bottom of the screen, and your BASIC program lines scroll upward under the menu. Which brings me to the other lazy feature, automatic line numbers!

To active auto-line numbers, press f6 and you will be asked "Jump Between Lines?(1-255)". After giving your answer and pressing RETURN, press f8. You will be asked "What's Your Line#?" After answering, press RETURN twice, and the first line number will appear. To deactivate auto-line numbers, just hit the RETURN key on a line that only has the line number on it.

The ever-present menu may get in the way at times, such as when you want to list your program. The menu indicates DIE! in the lower right hand corner, and by pressing f7 followed by the letter Q you turn off the *LazyBASIC* and receive a message in reverse video: "OK!! I'm Dead!!–Sys 49152 to revive me!!"

In order to eliminate the letters A-Q while using them to get other things, I stuffed the keyboard buffer with a space and a delete. The only time this becomes a nuisance is when you are in quote mode, which is a nuisance anyway!

If you use the *LazyBASIC* Quotemark, the ending quote will be preceded by a space and a delete symbol. Since these two cancel each other out, it has little practical significance unless your program line is very lengthy and the space and delete push you over the limit. For that situation and for mere cosmetic considerations, you may want to shove the last quote mark to the left after printing it out. Unlike a used car salesman, I am willing to point out such minor flaws.

Oh, I almost forgot. I couldn't stand to have two function keys left twiddling their thumbs, so f2 and f4 will toggle the colors of your screen and your border until they match the mood of your programming soul.

Finally, if you hit a key other than A through Q, a message will appear beneath the menu that informs you of that mistake. It changes from reverse video to regular lettering with arrows so you know if it has happened more than once within a line. Some finicky computers may generate this at odd times, and POKEing 650,0 to turn off key repeats can help eliminate these quirks. ☐

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GOT A MATCH?

For the C-64

By Walter E. Meyers

"Once upon a time in the Old West, two fellers named Buck and Wingo struck it rich. Now most everybody remembers the Gold Rush of '49, but it weren't nothin' alongside the big Jewel Rush of '94. Anyway, these two boys was prospectin' up in the Dismal Seepage Range when they come acrost the biggest strike you ever heard of—not emeralds or rubies, not even diamonds—but real, genyoowine Berzerkons, in every color of the rainbow. Wingo and Buck figgered for sure that they had found the end of the rainbow and here was the pot of gold. They opened up a mine right quick, and started countin' their chickens before they was hatched.

"You don't see Berzerkons much nowadays, but like I said, they come in pretty near any color, and there's four different kinds. You got your Larries, your Moes, your Curlies, and ever so often, your Shemps.

"Now, Buck and Wingo was rakin' it in down in the mine till one day the mountain gave a shrug, and the tunnel caved in. They was sealed up, but the boys didn't stampede; they knew the nearby miners had felt the quake, and by and by, somebody'd be along to dig them out. To pass the time, Wingo opined that he'd like to play a game. Well, Buck suggested for one of them to reach in the bag of Berzerkons in the dark and pull out a handful. The other'd light up a match, and study those stones until the match give out. Then he'd have to name the colors and kinds of the jewels from memory. And that, as I hear tell, is the story of how *Got a Match* got started."

Rudyard Kipling might have another idea, as might any reader familiar with the game played in his novel *Kim.* But even so, *Got a Match* adapts Kim's game to the Commodore 64 and illustrates several graphic and musical features in doing so. In fact, more than half of the program consists of data statements that use such features to add sparkle to what is essentially a very simple game.

A straightforward routine at lines 1400-1460 (refer to listing on page 86) programs the C-64's three voices for music. A single number is broken down in high- and low-frequency components. Three such numbers are read for the three voices, and a fourth provides the duration of the notes. This same routine could be used for any piece of music; both the *Commodore 64 User's Guide* and the *Programmer's Reference Guide* contain tables of the appropriate numbers for each note, and many other works provide the same information.

The next set of data, lines 2100-2140, sets up a short machine language routine to copy the character set into RAM so that it can be modified. The data in lines 2600-2910 performs that modification.

The program has sprites, too, for a bit of motion during the game. Lines 2200-2470 contain the data for the sprites.

Lines 2500-2560 provide another machine language routine to allow a joystick in port 2 to move a sprite left and right across the screen to predetermined settings, and to avoid the problem of sprite motion horizontally across the 64's "seam."

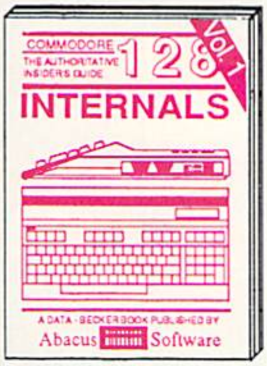
The last block of code, from 5000 to the end, provides an automatic way of checking whether all the data statements have been entered correctly. After you are finished entering the program, save it; then clear the screen, type "RUN 5000," and hit RETURN. The routine will read the data and compare the totals it gets with the checksums in line 5070. If there is an error, the routine will tell you in which group of data lines it occurs. After the checksums match up, lines 5000 to the end can be deleted before saving your final version of the program.

The difficulty of the game can be increased or decreased as you like by shortening or lengthening the amount of time a player gets to study the Berzerkons. Change line 470 to shorten or lengthen the study time. It reads:

```
470 I=I-48:D(1)=I+3:I=60-(I*5):CY=INT(
2.5*I)
```

As the program is set up now, the study time varies from about a minute (at level 1) to about fifteen seconds (at level 9). For a harder game, change the last of the commands in line 470 by substituting a lower number for "2.5"; try this in small increments, though. You might change the command to "CY=INT(2.3*I)", for example, then see how much study time you have on the hardest setting. ☐ *SEE PROGRAM LISTING ON PAGE 86*

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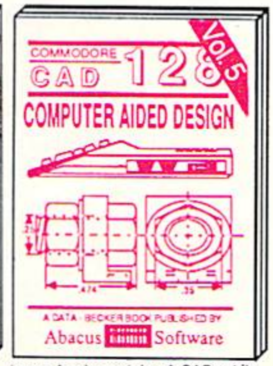
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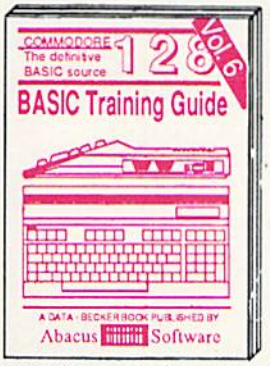
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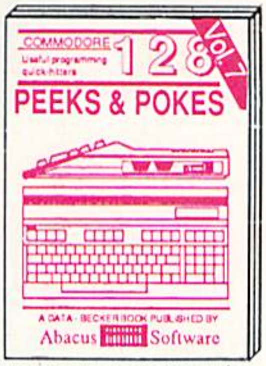
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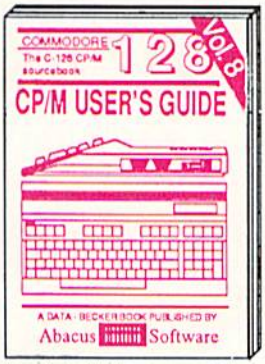
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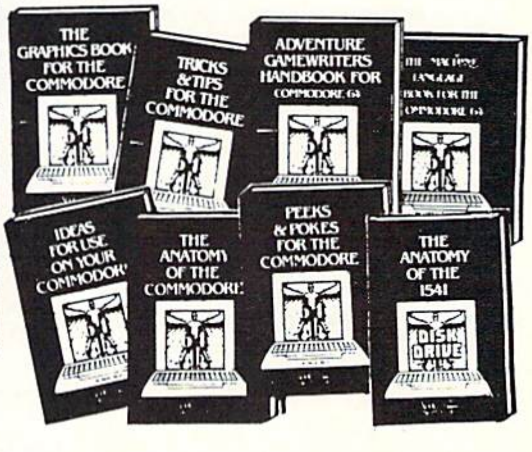
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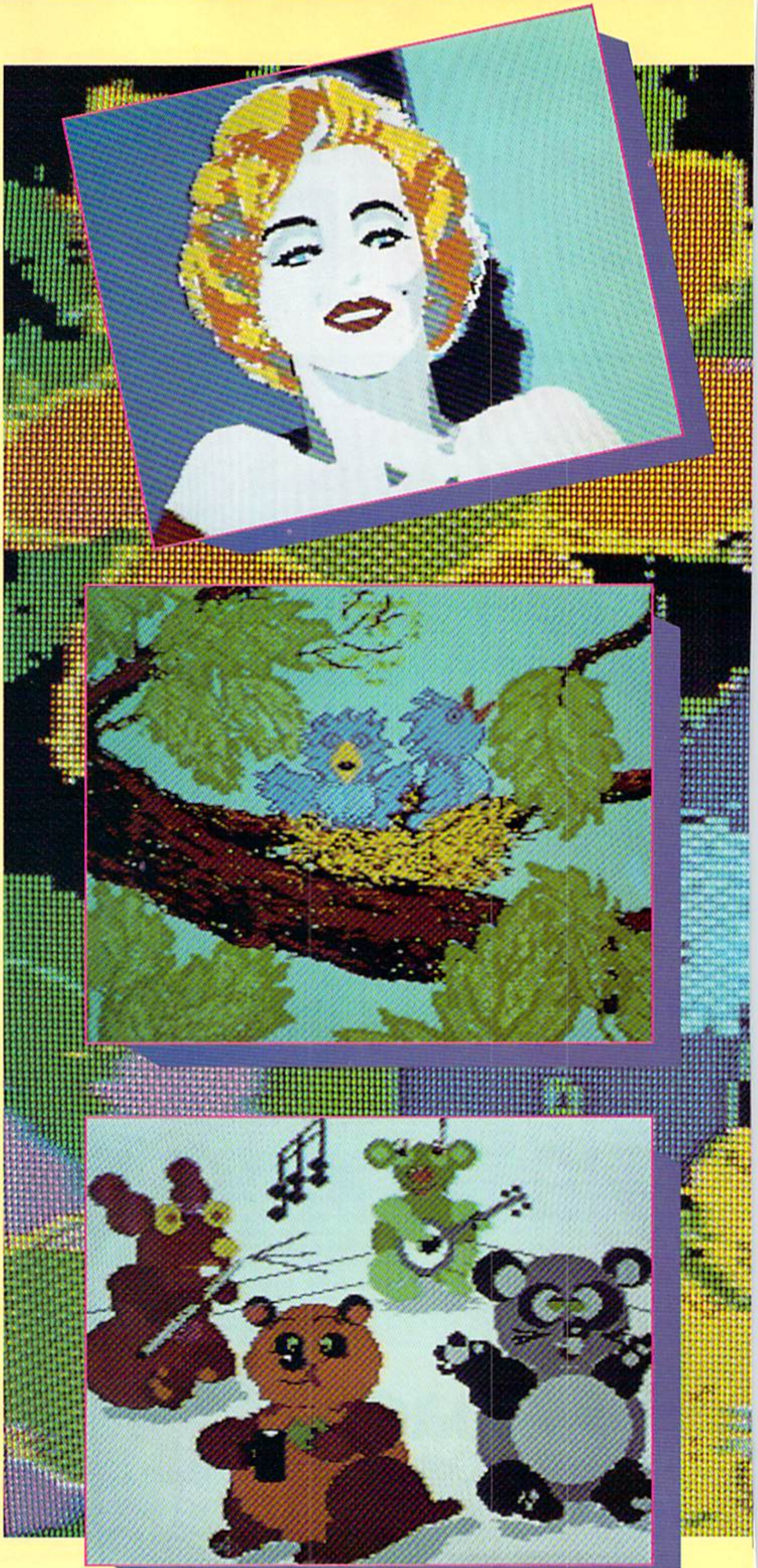
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Contributors to *Ahoy!'s Art Gallery* will receive royalties based on the sale of disks. Send your best work on disk, accompanied by a stamped and self-addressed mailer, to Morton Kevelson, P.O. Box 260, Homestead Station, Brooklyn, NY 11229. Indicate the drawing package that was used to create the image. If you employed a bit map of your own design, indicate the appropriate file parameters, i.e., hi-res or multicolor, location of bit map, screen or color data.

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Art Gallery images are available on disk. High resolution bit-mapped images are available in *DOODLE!* format. Multicolor bit-mapped images are available in *Koala* format. Each disk includes a slide show program for easy viewing. *DOODLE!* disks include a bit map screen dump utility for the 1525 or properly interfaced dot matrix printer. *Koala* disks include a set of custom routines for bidirectional conversion to other multicolor formats. The conversion routines were expressly developed for the *Art Gallery* by Michael Beutjer of K.T. Software, author of the *Koala Printer* program and *Quad Print* (June '85 *Ahoy!*). Formats presently supported are *Cadpic, Peripheral Vision, Paint Magic,* and *Flying Colors.* Disks are available for $15 from Morton Kevelson, P.O. Box 260, Homecrest Station, Brooklyn, NY 11229. Send a stamped and self-addressed envelope for a complete listing (or send $10 and receive a sample disk of *DOODLE!* and *Koala* images with slide shows).





As the media exploitation of Marilyn Monroe continues, Jay J. Smith (New York, NY) exploits the capabilities of the C-64 and *Koala* to produce *Marilyn*, featured at top left. Nested below it is *Birdies* by Dave Moroz-Henry (Downingtown, PA) also created with *Koala*. Next down is Earl Hamner's (Milpitas, CA) *Jamboree* (or should that be *Jambearee*?). At top right is the latest *Koala* image by Alberto Valsecchi (Milano, Italy), simply titled *Girl*—enough to keep most any man from ever saying *arivederci Roma*. At lower right is *Birds*, a *Koala* image by Joe Taylor (Virginia Beach, VA). This month's collection is laid out against a backdrop of the aforementioned Dave Moroz-Henry's *Flowers*, also shown unobscured at lower left.



STAR STRIKE

For the C-64

By Bob Eaton

You are stationed at the edge of the galaxy as the first line of defense against alien invasion. Just when you thought it was going to be a quiet day on patrol, you spot an unidentified ship on your scanners heading straight for you. Unknown to you is the fact that this is just the beginning of the kind of battle that few survive to tell about.

The stream of alien ships seems unending. At first the ships approach singly, later in pairs. Your shield energy is almost depleted. Even if you survive the cruel onslaught, the mother ship looms just out of sensor range.

Star Strike is an arcade style game program that is written mostly in machine language. It features 3-D graphics and four levels of difficulty. A joystick plugged into Port 2 is required.

PLAYING *STAR STRIKE*

Disk users should LOAD"STAR STRIKE",8 and tape users LOAD"STAR STRIKE". Type RUN and the program will automatically load in the machine language modules and start running. When the title screen appears, pressing a key or the action button on the joystick will bring up the level selection screen. There are four levels, with level 1 the easiest. The higher levels increase the speed of the game and also award more points. The game has three phases. To complete your mission you must survive all three. After you have selected the level of difficulty, press a key or the action button to start the game. Your ship will appear at the bottom of the screen and a crosshair will appear at the center. At the top of the screen is an indicator that displays your ship's shield energy reserves. You start the game with 20 shield energy units. A hit from one of the alient ships costs you one energy unit. After your shield energy is gone, the next hit will destroy your ship and end the game. Use the joystick to control the vertical position of the crosshair and the horizontal position of the crosshair and your ship. Pressing the action button will fire a missile. Because of the game's 3-D effects, accurate firing of the missiles may take a little practice. As when firing a rifle, you must lead your target. Extra points can be earned by shooting the aliens' incoming plasma spheres; however, this can be dangerous. If you miss, you might not have enough time to avoid taking a hit yourself.

Phase I is a one-on-one confrontation. You must destroy a total of 15 invading ships to complete this phase. Phase II increases the challenge. Here two of the invading ships may attack at the same time. To complete this phase, you must destroy 20 more of the ships. If you should survive, Phase III offers the hardest challenge. Your shields are useless against the mother ship's paralyzing ion beam. You must stop the mother ship before it is within firing range by hitting it in its only vulnerable spot: the port from which the deadly ion beam is emitted. The port will appear as a small flashing spot near the center of the ship.

Scoring is based on remaining shield energy, the number of ships destroyed, the number of alien plasma spheres destroyed, and the level of difficulty. A bonus is added to your score for destroying the mother ship.

TYPING IN *STAR STRIKE*

Star Strike is composed of three separate programs. The first program (filename STAR STRIKE) is in BASIC and automatically checks for the current device number, then loads in the two remaining machine language programs. The two machine language programs require the use of the *Flankspeed* program when entering (see page 85). Be certain that you save all three programs on the same disk.

Tape users will need to be certain that the three programs are saved to tape in the proper order. (STAR STRIKE first, followed by SPRITES, and finally SS). To prevent the possibility of accidentally overwriting a previously saved program, I would strongly suggest that the three programs be saved on different sides of two tapes. Then save the programs in proper order back to another tape.

For proper operation be sure to save the programs with the listed filenames. ☐

SEE PROGRAM LISTING ON PAGE 89

S.O.S.

***Ahoy!*'s editors love taking time out from their already overcrowded work schedules to help you with problems regarding programming, hardware, or any other aspect of Commodore home computing. We invite you to send your questions to *S.O.S.*, c/o *Ahoy!*, Ion International Inc., 45 West 34th Street—Suite 407, New York, NY 10001.**

I have a Commodore 128, 64, and VIC 20. I use the 128 and my boy uses the 64. We both started out with the VIC 20 and I've got all the Scott Adams games on cartridge. The problem is that the VIC 20 is in the closet now that we both have upgraded. You mentioned quite briefly about these games being transferable to disk. I've tried everything that I can think of, but still cannot do it. Could you please explain the method of doing this? Any help would be greatly appreciated. —Mike Morse
Grand Prairie, TX

What a sad fate for a VIC 20. Perhaps you could find a deserving young person who might benefit from its use. To transfer your VIC 20 cartridge software to disk you will have to dig out the VIC 20 from your closet at least one more time. Hook up the VIC 20 to your disk drive, insert one of the cartridges, and power up the system. You should now perform the following series of POKEs from the keyboard in immediate mode:

```
POKE 43,0
POKE 45,0
POKE 44,64
POKE 46,128
```

Make sure there is a formatted disk in the drive with at least 65 blocks free. Just perform a SAVE to the disk using an appropriate file name. The resulting 65 block program file will contain the 16 kilobyte contents of the cartridge ROM.

*The series of POKEs above has "fooled" BASIC into thinking that there is a program in memory whose starting and end addresses happen to coincide with the cartridge ROM. Locations 43 and 44 are a pointer pair, or vector, which tells BASIC where the start of the current program is. You can calculate this address by 64*256+0=16384. Locations 45 and 46 are a vector which points to one byte after the end of the current program. This is also the start of BASIC's variable storage space. In this case the address is 128*256+0=32768.*

This procedure can be used to save the contents of any range of the computer's memory. Just reverse the above calculations for the desired start address and address plus one and perform the proper POKEs. Note that 43 and 45 will contain the remainder of the division by 256. This technique works on both the VIC 20 and the C-64. The C-128 has a different set of locations which perform the corresponding functions. However, the complex bank switching implemented on this machine makes this an impractical technique. Fortunately BASIC 7.0 has the BSAVE and BLOAD commands which take care of these things.

When you have SAVEd all the programs you may restore the VIC 20 to the closet till it is needed once again. The following boot program will automatically start up the games for you on your C-64 or C-128. Just enter the appropriate file name in the LOAD command of line 10 before SAVEing.

```
10 IF FL=0 THEN FL=1:LOAD"
file name",8,1
20 POKE 53281,1:REM MAKE
SCREEN WHITE
30 SYS 32592:REM START
GAME
```

While this particular group of cartridge programs will work on the new machines, this is not usually the case. You will also note that the text is still formatted for the VIC 20's 22 column screen and the SAVE game feature still goes to the cassette.

—Morton Kevelson

READER SERVICE INDEX

The publisher cannot assume responsibility for errors in the above listing.

TIPS AHOY!

Compiled by Michael R. Davila

BRANCHING OUT

It is often advantageous to use the function keys of the C-64 to control the flow of a program. The dilemma is the method by which to branch to the appropriate routine for the key that is pressed. The ASCII codes for the function keys are 133 through 140, arranged f1, f3, f5, f7, f2, f4, f6, f8. As a hypothetical case, assume the program has a menu with eight options. The following two lines will get characters from the keyboard until one of the function keys is pressed.

```
100 GET A$: IF A$="" THEN 100
110 X=ASC(A$):IF X<133 OR X>140 THEN 100
```

The variable X now contains the ASCII code of the function key that was pressed. A simple method for branching to the proper routine would be to use eight IF statements such as these:

```
210 IF X=133 THEN 1000 : rem F1
220 IF X=137 THEN 2000 : rem F2
230 IF X=134 THEN 3000 : rem F3
240 IF X=138 THEN 4000 : rem F4
250 IF X=135 THEN 5000 : rem F5
260 IF X=139 THEN 6000 : rem F6
270 IF X=136 THEN 7000 : rem F7
280 IF X=140 THEN 8000 : rem F8
```

There is a way to accomplish the same thing with only one line. The BASIC commands ON..GOTO and ON.. GOSUB can be used to branch to a series of line numbers based on the value of a variable. If we subtract 132 from the ASCII code in the variable X, we will get a number in the range 1 - 8. The BASIC line numbers should appear in the order of the original ASCII codes. Using the line numbers from the IF statements above, the single line solution would read as follows:

```
200 X=X-132 : ON X GOTO 1000,3000,5000,
7000,2000,4000,6000,8000
```

The command ON..GOSUB can be used exactly the same way. When using this method, it is a good idea to have one of the branches allow an exit from the program.

–Thomas P. Shultz
Clarion, PA

BASIC SCREEN SIZER

To make a program truly compatible on all Commodore machines, you shouldn't use any POKEs, PEEKs, SYS commands, etc. But what do you do about screen size? Commodore thoughtfully put a Kernal routine in their ROMs to do just that... but as an exercise, let's keep things strictly in BASIC (no SYS's, remember?). Here's how it's done:

```
100 A$="":B$=""
110 OPEN3,3:FORSZ=1TO79:GET#3,A$
120 IF A$<>CHR$(13)THEN NEXT
130 PRINT"SCREEN SIZE IS";SZ;"COLUMNS"
140 CLOSE3:END
```

You can then do whatever you want with variable SZ, the screen size in columns. This works because the Commodore computers think of their screens as a device, just like a disk drive, printer, or tape deck. Screen devices are always #3, and can't be changed very easily. Typically the screen is a write only device, but by opening a channel to device 3 (open3,3) and then GETing characters from that device (get#3,a$) we can count the number of characters received until a carriage return (C/R) is encountered. Since C/R signifies the end of a line, that's all there is to it; we've got our screen size. A Commodore 64 will send back 40 characters and then a carriage return, a VIC 20 will send 22 and a C/R, and the C-128 (or an old 8032) will send 80 plus a C/R, assuming that you're in 80-column mode.

–David Paulsen
Renton, WA

ANYBODY ELSE WANNA SIGN?

A postscript to the April '86 tip "AUTOGRAPHED 128'S": apparently there are more than three designers of the C-128. In immediate mode type SYS 32800,123,45, 6 and hit RETURN. At that point the screen will clear and the names of both the hardware and software designers will appear.

–Bob Ossentjuk
Sierra Vista, AZ

CUSTOM CHARACTERS ON THE C-128

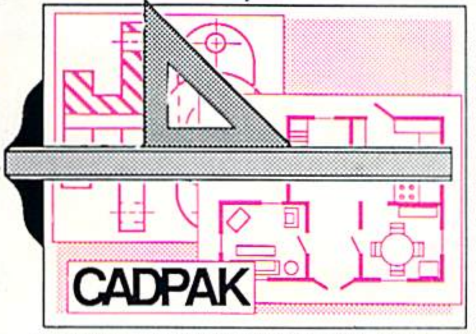
This short piece of machine language moves the 128's character set from ROM to RAM, BANK 0, at address 8192. This area is protected when you implement a hi-res GRAPHIC command. Use a BANK 0 command and some appropriate POKE's and alter the character set to your heart's delight. The addresses of the start of each subset of characters are: upper case, 8192; upper case reversed, 9216; lower case, 10240; and lower case reversed, 11264. Moving the entire character set using BANK, POKE, and PEEK takes about 50 seconds; in FAST mode this program does the same job in less than two seconds.

–R. Harold Droid
Seattle, WA

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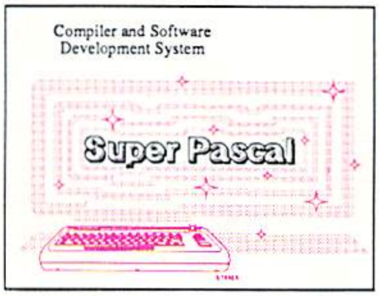
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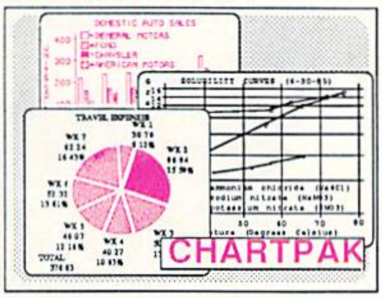
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```
10 GRAPHIC3:GRAPHIC0:REM RESERVE SPACE
20 BANK15:SUM=0:FORI=2816TO2869:READJ:SU
M=SUM+J:POKEI,J:NEXT:IFSUM<>7491THENPRIN
T"ERROR IN DATA STATEMENTS":END:ELSESYS2
816:REM MOVE THE CHARACTER SET
30 DATA 169,0,133,250,133,252,169,208
40 DATA 133,251,169,32,133,253,169,252
50 DATA 141,185,2,169,16,141,54,11
60 DATA 160,0,169,250,162,14,32,116
70 DATA 255,162,0,32,119,255,200,208
80 DATA 241,206,54,11,240,7,230,251
90 DATA 230,253,76,26,11,96
100 POKE2604,PEEK(2604)AND240OR8:REM TEL
L SYSTEM WHERE CHARACTER SET IS LOCATED
```

C-64 DISK LOADS WITH C-128 EASE

Are you tired of "PRESS PLAY ON TAPE"? If so you will like this very short program that makes eight the default device number. The routine, only 18 bytes long, does not use any popular programming space. It takes advantage of the fact that the LOAD and SAVE vectors (816-819) are followed by eight free bytes. The other seven bytes have been placed in the RS-232 pointer locations, another normally unused area. The routine needs no SYS number. Just run it, and the SAVE and LOAD vectors will be changed to pass through the seven byte additions. A RUN STOP/RESTORE will reset the vectors, but will not erase the rest of the program. Four POKEs will reinstate it.

```
POKE816,52:POKE817,3:POKE818,247:POKE819
,0
```

This utility allows commands such as LOAD"program name. It eliminates the necessity to use the ending quotes and the ,8. —Thomas B. Smith Gallipolis, OH

```
1 FORT=816TO826:READS:POKET,S:NEXT
2 FORT=247TO253:READS:POKET,S:NEXT:NEW
3 DATA 52,3,247,0,162,8,134,186,76
4 DATA 165,244,162,8,134,186,76,237,245
```

SLOW PRINT

By adding the following lines to your program, PRINT commands in your program will be executed slowly enough for you to be able to read the print on the screen as it is being printed! This will add a special touch to adventure games, and also to user instructions that are displayed before the actual program begins.

```
10 X=56324:POKEX,24:POKEX+1,0:FORD=1TO2:
NEXTD
30 POKEX,75:POKEX+1,46
```

Line 10 POKEs a smaller number into the computer timer so it will run at a slower rate. Line 30 returns your program to the normal rate after the slow PRINT. Add

the following two program lines to 10 and 30 above, and see how it works for yourself. —David S. Krause
Grissom AFB, IN

```
5 PRINT"[CLR]"
20 PRINT"SEE HOW SLOW THIS PRINTS ON THE
 SCREEN"
```

EASY PLOT

Here is a simple and very fast cursor movement routine that is as easy to use as IBM's LOCATE command. The entire routine is neatly hidden in a BASIC REM statement, allowing you to include it in any BASIC program without first loading a special machine language loader. To create the cursor movement routine first type and RUN the following BASIC program:

```
10 REM..............................
20 FOR J=2054TO2076:READX:POKEJ,X:NEXT
30 DATA 169,147,32,210,255,32,253,174,32
,158
40 DATA 183,202,134,214,32,241,183,202,1
34
50 DATA 211,76,16,229
```

If you typed in the program correctly you will notice that after running the program, line 10 will have changed. Don't worry, the strange jumble of BASIC key words is only the machine language routine as seen by the BASIC interpreter. The next step is to delete lines 20, 30, 40, and 50. Then SAVE line 10 to disk or tape. This will allow you to use the routine at later dates. There is only one restriction to using this routine, and that is it *must always* be the first line in any BASIC program. The EASY PLOT routine will allow you two different cursor movement options. The first cursor option will allow you to clear the screen and place the cursor, while the second option allows you to place the cursor and leave the screen display intact. To clear the screen use the format 100 SYS 2054, ROW#,COL# and to just place the cursor use the format 100 SYS 2059,ROW#,COL#. In both cases ROW# is the range 1 - 25 and COL# is the range 1 - 40. For example, if you wanted to place the cursor in the upper left corner of the screen after first clearing the screen and then place text in the center of the screen you would use the following program lines.

```
10 REM (AS FIRST CREATED)
20 SYS 2054,1,1:PRINT"EASY PLOT":REM CLE
AR AND PRINT
30 SYS 2059,12,13:PRINT"BY S.D. BETESH":
REM PRINT ONLY
```

—Saul D. Betesh
Kingston, ONT

REAL RANDOM NUMBERS

BASIC's random number generator isn't totally random. It also isn't very convenient for ML programmers to use. Here's a method for generating totally random numbers in machine language, or BASIC, by using the SID chip's random noise waveform. Set the high byte of the voice 3 frequency control to 255 so it's too high a pitch to hear. Then turn on bit 7 of the control register to select the noise waveform. Now you can read the random noise generator output for random numbers between 0 and 255.

For machine language, enter the following to set up voice 3:

```
LDA $D41B
```

Then read your random numbers by:

```
LDA #$FF
STA #$D40F
LDA #$80
STA $D412
```

For BASIC, enter the following:

```
10 POKE 54287,255
20 POKE 54290,128
30 PRINT PEEK(54299)
```

—Robert Olsen
Woodinville, WA

QUEEN'S AND BISHOP'S TOURS

For the C-128

By Daniel L. Miller

In the November 1985 *Ahoy!*, Richard Ramella presented *Knight's Tour* in which we were challenged to cover the chessboard with the moves of the Knight. In my companion program, you must tour the board with either the Queen or the Bishop.

The Queen must cover all the squares and end on the same square on which she began. Legal moves are either parallel to the sides of the board or along the diagonals for any number of spaces. In deference to her royal lineage, the Queen can revisit a previously covered square. The Queen can tour the chessboard in 14 moves.

The Bishop must begin on a white square and move diagonally. He may not occupy a formerly covered square. The Bishop's tour can be accomplished in 17 moves.

When the chessboard appears on the screen, enter the starting Row/Column location of the piece; for instance, 3B. Remember, the Bishop must start on a white square. Press f1 to end the puzzle. If you would like to see the solution, answer 'Y' to the next prompt and the puzzle will reset and solve itself.

When I began to write this program, I had intended to do so in 64 mode on the Commodore 128. However, when I reached the routines for creating and manipulating the sprites for the Queen and Bishop, I quickly realized that I was ignoring the normous potential of the C-128's BASIC 7.0. Instead of using a separate sprite editing utility, I had the SPRDEF mode which enabled me to design the sprites while I was working on the program.

When I was satisfied with the two sprites, I PEEKed at the 128 bytes of the sprite storage location, starting at 3584, and transferred the values to DATA statements in my program. As you can see in lines 1180 and 1210, I eliminated all the zero values, since the interpreter automatically assumes zero if no other value is given. Instead of a series of POKEs to various registers, I initialized the sprite with the SPRITE command in line 80: SPRITE (number 1-8)[,on (1)/off (0)][,foreground color (1-16)][,priority (0 in front, 1 behind)][,x−expansion (0 off, 1 on)][,y−expansion (0 off, 1 on)][,mode (0 standard, 1 multicolor)]. Moving the sprite was just as simple with the MOVSPR command, also in line 80. This places the chosen sprite (1=Queen, 2=Bishop) at the fixed (x,y) screen coordinates of (40,140). To move the sprite to a new square, I determined the number of spaces moved (up/down/left/right/diagonally) in order to evaluate the offsets DX,DY in line 560. The sprite moves one space at a time within the DO UNTIL...LOOP.

The CHAR command is similar to PRINT AT in other dialects of BASIC. Although intended primarily for placing characters on a high-resolution screen, it can be used, as here, on a text screen. GETKEY eliminates the need for a loop (as 10 GET A$:IF A$="" THEN 10). The computer waits until a key is pressed and then continues. RESTORE can be reset to a specific line number as illustrated in lines 850 and 870. At startup, the function keys are loaded with several useful commands (DIRECTORY, RUN, LIST, etc.) but can be redefined with the KEY command as in line 1140. When I had finished the program, I entered RENUMBER to resequence the lines. These are the commands which I used in this program; however, there are many other commands for graphics and sound which must be seen to be appreciated. □

SEE PROGRAM LISTING ON PAGE 101

tcp COMMODORE

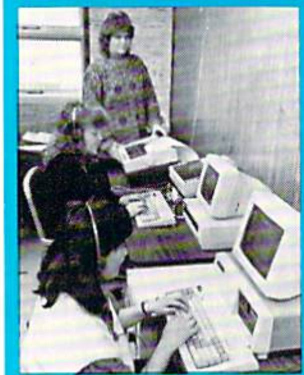
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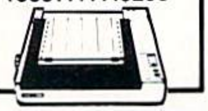
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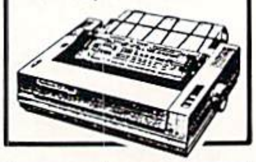
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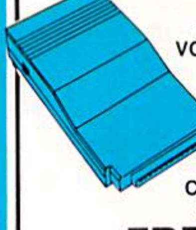
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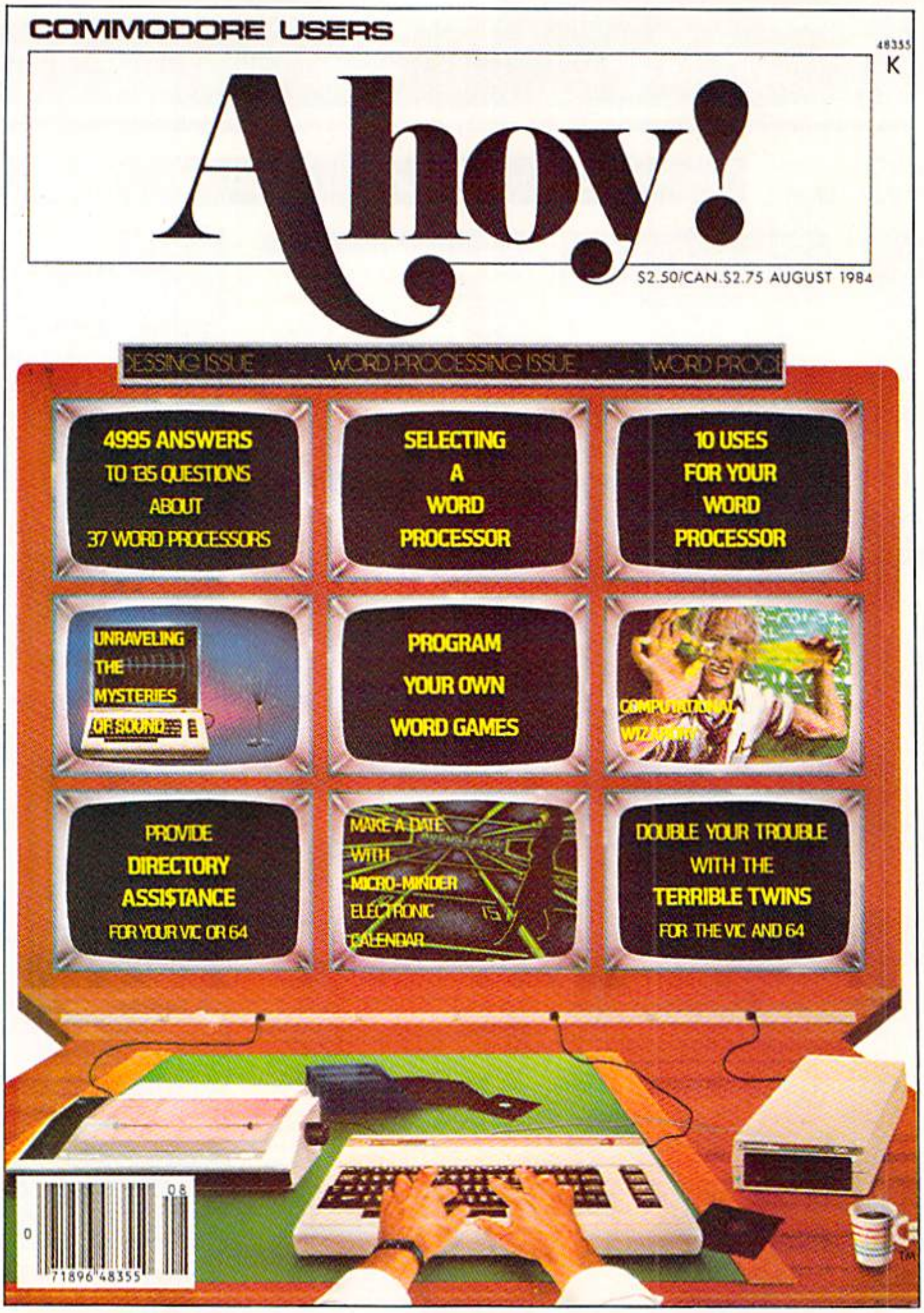
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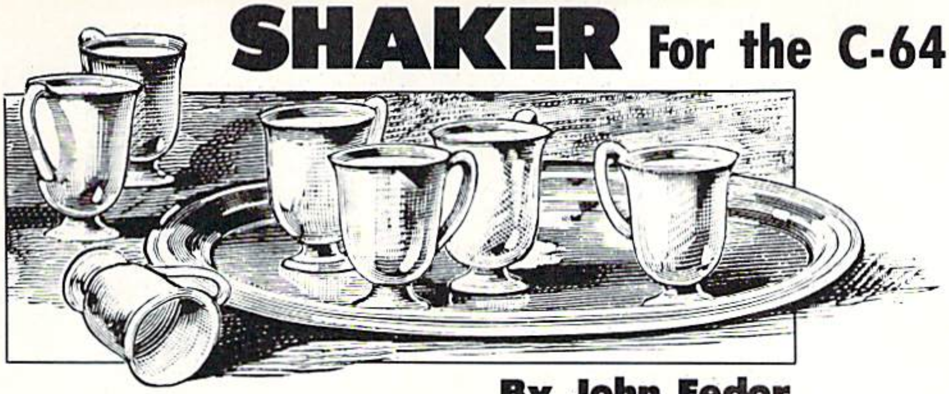
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SHAKER For the C-64



By John Fedor

Remember that con game with the three peanut shells and the peanut that never seemed to be under the shell you picked? Now you get to try your luck again. Only this time, there are seven cans of pop, six of which are shaken up. You must pick the correct one or else you get to drink pop the hard way!

In order to enter the program, use *Flankspeed* (page 85) to help spot typing errors. Use a starting address of $C000 and an ending address of $C878. Once it is entered, you can LOAD it (,8,1 or ,1,1) and start it by typing SYS49152 <RETURN>. The title screen will be displayed.

When starting the game, you get to choose your starting level (1-5). You will not be penalized for starting on a higher level. In fact, you get extra points for starting on higher levels. Move the joystick (Port 2) left or right to choose the level and press the fire button to start the game.

You will then see seven red pop cans on the screen. The computer will pick six of them and shake them. The computer always shakes them at the same speed. Remember which can was *not* shaken.

Now comes the hard part. The computer will shuffle the cans about 15 times. The lower the level, the slower the speed. Level 11 is truly for the super eye. Once the shuffling is completed, you move the flashing can to the correct can. Press the fire button to choose the can. If you are right, it makes a certain noise. If not, the can sprays out the pop. You get three attempts per game. My highest score is 2590. ☐

SEE PROGRAM LISTING ON PAGE 103

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Reviewers and users have heaped the following praise on the **BLITZ!**: "The **BLITZ** basic compiler is a dream come true for BASIC programmers." Compute!'s Gazette Jan 1985 "worth its weight in gold." TPUG Mar. 1985. "Wonderful" "Fantastic" "I can't imagine programming without it" User comments. It is even more popular with professional programmers. Many commercial programs now say "**BLITZ!**" when they are listed. The ultimate accolade for **BLITZ!**.

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MEETING THE ULTIMA CHALLENGE

How to Find Fame and Fortune in Lord British's World

By Tracie Forman Hines

Featured This Month:

Hundreds of thousands of gamers have stayed up late trying to unravel its secrets since the first installment of the *Ultima* series made its debut in 1980. Each title is more convoluted than the last, and the gamer generally begins with a weak character who is totally ignorant of the surroundings or the true goal of the quest.

Richard "Lord British" Garriott's creation, unlike most of the adventures of the time, derives much of its play value from its role-playing aspects. A character develops an individual personality as the computerist makes discoveries about the land and battles the creatures of darkness to earn experience points.

Those familiar with non-electronic role-playing games will immediately recognize the pattern and slip into the *Ultima* universe. Newcomers will have to study this Horatio Algerish view of life in which the goal is to turn a weak persona into a powerful one.

The only scenario which hasn't stood the test of time is *Ultima I.* It hasn't lasted well mostly because of its primitive graphics and relative simplicity. While the original is still a great collector's item, this article deals with winning the follow-up scenarios.

The Road to Success

Each title differs from the others in the series, but there are certain universal *Ultima* strategies that can help even novices avoid pitfalls and painful deaths.

The most important tools a gamer needs to solve any of the scenarios are a notebook, a pad of large-grid graph paper, and a pen. Transact with everyone you meet in towns, villages, or cities, and write down what you learn. This is the only way to solve the adventure. It's a good idea to make lists of the residents of towns and villages. This way, you'll know where to find them.

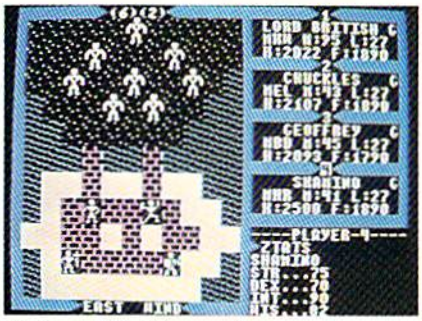
Lord British is the final arbiter of life and death in the *Ultima* realms. The game often starts a player a mere stone's throw from his castle. Visit the monarch often to get the benefit of the extra levels and/or hit points the character earns as quickly as possible.

Carry lots of food, as much as the character can afford. The absolute minimum amount is about 200 units, enough to stave off starvation during a coast-to-coast hike, even if the party gets lost briefly. Keys, torches, and gems also come in handy, so stock up at the local Thieves' Guild.

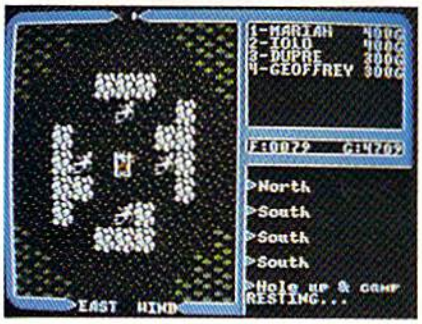
If you think you've seen every location in a town, village, or dungeon level, peer at a gem just to be sure. Lord British can be devious, and he often hides vital areas or characters just out of sight. Gems are especially useful in dungeons, where they can find secret doors, treasure chests, stones, and other goodies.

Know the Neighborhood

Unlike many other adventure games, *Ultima*'s scenarios require little real mapping. After a few treks, most players will be familiar enough with the map to recognize landmarks. Of course, the cloth maps enclosed with each game help a lot, so remember to decipher the hieroglyphs. They can point the way towards specific places or solutions that would take a long time to figure out on your own. Make a note of any location not flagged on the cloth map. Use pins if you don't want to deface it.



Ultima III: *bigger than precursors.*
READER SERVICE NO. 230



Ultima IV: *honesty is best policy.*
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Dungeons and towers are the exceptions to the "no map" rule. Map each square carefully, or you could end up running around in circles, repeatedly stumbling into the same traps or missing secret doors that lead to the heart of the dungeon. Hint: it isn't necessary to explore towers or dungeons to win *Ultima II.* If you don't need the money, don't waste your time or hit points.

Never, but never, leave the game running while you get up to answer the phone. Your character could easily starve or be attacked and killed in your absence. Use the Z command, which suspends all game activity.

In *Ultima III* and *IV*, always have a few characters readily armed with missile weapons. It's the only way to beat certain monsters, especially seafaring and poisonous types. Position archers behind swordsmen, so both can attack.

Secrets of *Ultima II*

This scenario pits a single player against all the forces of Minax the Enchantress, who's wreaking havoc on the land in revenge for the destruction of her lover in the first episode. The player's first priority is to find and master the Time Doors, the now-you-see-em, now-you-don't portals which appear according to the phase of the moons.

Besides talking to the local townsfolk, try bribing people, especially hotel clerks. There's a lot more happening than meets the eye. Most players will have to travel to each time period more than once.

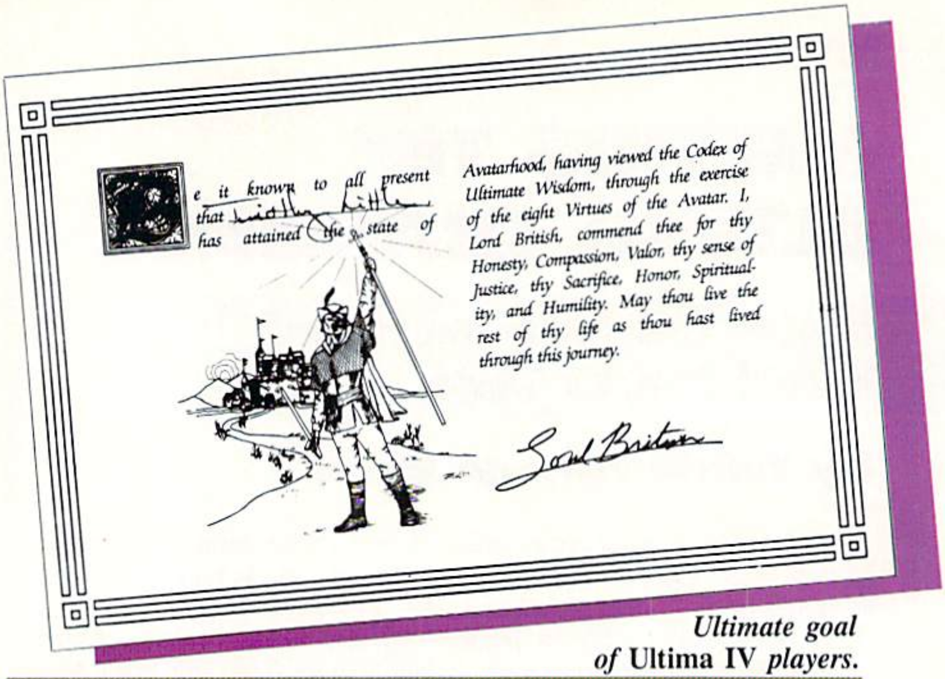
Try taking different technologies through time doors. But make sure you know where you're going before taking the rocket ship into space. Aimlessly wandering around the universe often proves fatal. Once sure of the destination planet's coordinates, and those for the landing strip back home, explore a few out-of-the-way planets just to see what they contain.

Exodus or Bust

Ultima III is much bigger and more complicated than its predecessors. Up to four individual characters join forces against evil. A character's race and class influences his or her attributes, so read the section on creating characters carefully before generating a party. For example, dwarves make lousy magic users.

This game requires players to go through a pseudo-death sequence to find a hidden area. While it may be too painful to imagine, allow events to take their course, and you could just be pleasantly surprised.

The Moon Gates instantly teleport the party from one place to another, sometimes landing the group in an otherwise inaccessible spot. Experiment with the Gates and write down which Gates lead where during each phase of the moon.



Ultimate goal of Ultima IV *players.*

Keep track of everything people say, and the order in which they say it. Write down comments verbatim, because the party may be required to do something in a particular sequence later in the game.

Use the "Appar Unem" spell to open chests whenever possible. No character has to die a miserable, poisoned death. If anyone in the party is poisoned, run, don't walk, to the nearest Healer.

Make sure each character carries a reasonably equal distribution of food into dungeons. That way, if gremlins steal food from any one person, other characters will have enough to compensate for awhile.

The "exotics" townies sometimes mentioned are not some sort of strange new spells. They are armor of the highest quality. "Exotics" are not located on the mainland.

In Search of Perfection

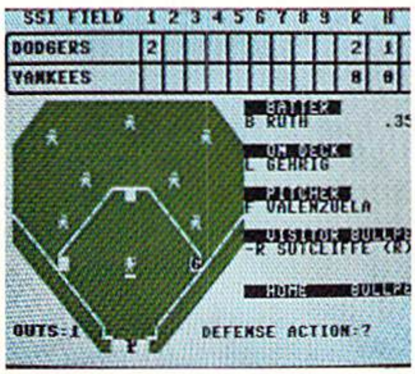
In *Ultima IV,* players *must* behave like heroes to make any progress. Stealing is possible, for example, but criminality sets the character back so far that it really isn't worth the trouble.

Among the actions that will advance characters quickly: "tipping" healers 100-400 hit points; sparing non-evil creatures; and dealing honestly with all non-player characters. Actions which will retard character growth include: stealing anything

PLAY IT AGAIN, CASEY

By Arnie Katz





World's Greatest Baseball Game *and* Computer Baseball *are two examples of games allowing managers to match teams of different eras.*

from anybody; stirring up trouble in towns; habitual lying; and running away from a lot of battles.

Go after the rune and mantra in Jhelom as soon as possible. Actually finding what you need might require bad enough behavior to lose you partial avatar points.

The way the gamer answers the gypsy fortune teller's questions shapes the character's starting position. If you're not happy with the character you begin with, for example, the best way to cut frustration is to start over from scratch.

Talk to Hawkwind often, since only he can tell you how much progress you're making. Try to elicit some sort of question from every character you meet. If someone hasn't asked a question, you probably didn't have a deep enough conversation with them.

Hole up and camp often. It's the best and cheapest way to regenerate lost hit points (unless you happen to be close to Lord British's castle, in which case inquiring about his health will restore everyone to full HPs). If the computer tells you that resting has had no effect, it's lying. Characters might not have any hit points restored, but their magic points always return to full strength after a nap.

Never press "0" when asked how many rounds you want to meditate at a temple. Not only will the meditating last almost forever, but you stand a good chance of losing avatar points if you stop prematurely. It takes quite a while to earn them back.

Mix up plenty of spells before entering dungeon rooms. Once engaged in battle, you can't concoct a handy fireball. The dungeons all connect at the bottom, so you can locate out-of-the-way dungeons by going all the way to the eighth level and walking through an altar room. You'll enter a different dungeon. To see exactly where the dungeon is on the terrain map, cast an "X-it" spell.

The ideal party has eight characters, one from each class. Potential party members can be found in the towns which represent their character classes.

If you kill a monster from a boat, it doesn't leave a chest of gold and no party member earns experience points. You don't have to kill every monster in an attacking party to earn financial reward, though. Forcing them to retreat earns a chest.

The phases of the moons are important when hunting mandrake and nightshade. Look for these most powerful reagents when the moons are dark. Moons continue to cycle while you mix reagents or hit "Z" (pause). If you're waiting for a moon gate or the right phase of the moon, use either of these methods to wait for the perfect moment. That way, you won't have to battle marauding monsters.

Final Advice

It may be hard to believe while you're banging your head against the monitor screen in frustration, but everything in each *Ultima* game has a solution hidden somewhere. If talking doesn't immediately provide a clue, try it again! Local gossip is the key to winning.

Origin Systems, creators of *Ultima III* and *Ultima IV*, market their own hint booklets. They provide no outright answers, only phrases to jog players' imaginations and nudge them towards solutions. The hint books are available directly from Origin for $12.95 each. Players who need even more help can call the company direct and get straight answers from Origin's friendly, knowledgeable staff.

Unfortunately, Sierra, publisher of *Ultima I* and *II*, doesn't offer the same support. Fortunately, there are a variety of good adventure game books on the market that offer complete solutions.

Happy orc hunting! And remember, in the *Ultima* universe, only the strongest strategists survive.

Origin Systems, 340 Harvey Rd., Manchester, NH 03103 (phone: 603-644-3360). ***—Tracie Forman Hines***

Getting the Most out of Computerized Statistical Baseball Games

Shortstop Ernie Banks lungs into the hole! He spears the ball and, in one fluid motion, shovels it to Rogers Hornsby at second base. The Rajah steps on second as Willie Mays slides into the bag to try to break up the double play. Hornsby pegs to first, where Don Mattingly stretches out to catch the ball a split second before Babe Ruth can touch first base. The St. Louis Aliens, masters of the Royal Amateur Micro Baseball League Organization (RAMBO), trot off the field with another victory.

There's only one way superstars of different eras and teams could play on the same field: a statistical baseball game. Statistical baseball employs mathematical models which represent the performance of actual players of the present and past. These models plug into algorithms which express the interrelationships among players in each specific situation.

The result of all this high-powered arithmetic is that statistically based baseball simulations replicate the real sport so that gamers can enjoy the vicarious challenge of making the same decisions that perplex Major League managers, coaches, and general managers. In other words, if you have Wade Boggs, he will hit, throw, run, and field for your team the same way he does for the Boston Red Sox.

Non-electronic statistical games, popular since the early 1950s, have spawned a hobby group which includes hundreds of play-by-mail and face-to-face leagues and hundreds of thousands of devoted players. The computer has proved to be a real bonanza for armchair managers, eliminating the need to roll dice to generate random numbers and consult mountains of charts on every play.

Commodore owners can choose from among four different statistical baseball titles: *Computer Baseball* (Strategic Simulations), *World's Greatest Baseball Game* (Epyx), *Statis-Pro Baseball* (Avalon Hill), and

Micro League Baseball (Micro League Sports Association). All are easy to learn and reasonably entertaining, and all have sufficient statistical accuracy to serve the needs of Walter Mitty-type managers. (See the chart on page for a comparison of these programs.)

Paths to Diamond Glory

Matching your favorite team against its principal divisional rival, the league titlist, or the world champion is usually the first thing a new stat replay gamer tries. It's always fun to see if one's strategizing could reverse the outcome of that crucial game or key series, but lovers of baseball simulations have come up with several other ways to have fun with such programs.

One choice, an especially good one for those who generally play solitaire, is an extended replay. Many find this activity very satisfying. It allows for direct comparison between actual performance and statistics produced with the game, and it gives the electronic skipper a chance to change sports history.

Although the truly ambitious may elect to restage an entire Major League season, using the disks which the publishers of all baseball programs sell for this purpose, this is a major undertaking. A full year's schedule consists of more than 2,100 individual games, and that's over 1,200 hours of actual playing time.

A better choice for most computerists is a replay of one team's season. It's something even a time-pressured manager can complete in a reasonable period of time, and it neatly avoids the boredom of replaying contests between unfamiliar or unappetizing teams.

How exacting to make the replay is a matter of personal choice. Purists consult back issues of *The Sporting News* or the daily newspaper to determine the exact line-ups used in each game. This generates the most lifelike statistics, and makes it easy to compare the computerist's achievements with those of real managers.

Truthfully, most fans of computer baseball will find this rigorous method entirely too much work. For most, simply trying to use players in a more or less realistic fashion is close enough. The statistics won't match the real major league totals exactly, but they'll be close enough to provide a frame of reference and points of comparison.

Another approach, good for solo play or as a day-long diversion at a summer barbeque, is a tournament. Let each competitor pick a team from a particular season, draw up an elimination ladder, and play toward a championship. An eight-team tourney requires just seven games—about four hours—to pick a winner. Constructing a tournament employing famous teams of the past is an exciting variation.

Many feel leagues provide the ultimate in stat replay baseball pleasure. Their seasons frequently extend through the winter, giving baseball zealots something to do when the only hardball news involves arbitration hearings.

Computerists who can't find local competition can join a mail loop. The manager of the visiting team in each series sends instructions to the home manager, who plays out the contest according to the guidelines.

Since this system is less than ideal, many computer baseball fans choose to join face-to-face circuits. Groups which have access to a computer room often meet one to four times per month to play one series each. Leagues without such facilities generally require the manager of the road team to travel to the home manager's computer to play a three or four game series.

Finding managers is a cinch. Most computer stores will post a small ad on the wall. Other good places to let the world know about your league are school, office, or supermarket bulletin boards. And you might give the local users group or BBS a whirl, too.

Though quite a few leagues utilize stock teams, alternative formats allow the participants to show their ability as general managers as well as field generals. The most popular is the draft league. Each manager picks the team of his or her dreams from a pool of eligible free agents. Generally, the ballplayers are updated after each real-life season to reflect their new level of performance, and league teams can retain the rights to a player from season to season.

All four of the programs on the market are fun to play and give would-be managers a chance to strut their stuff. For the dedicated armchair manager, however, all disks are not created equal.

For instance, if a draft league is your heart's desire, *Micro League Baseball* and *Computer Baseball* are the best choices, because they permit easy trading of players between teams. On the other hand, if full-season replays are the goal, *Statis-Pro* offers the biggest selection of complete past years.

The accompanying chart rates the four titles currently on the market in key areas.

RATING THE STATISTICAL BASEBALL GAMES

	Micro League Baseball	Computer Baseball	Statis-Pro Baseball	World's Greatest Baseball Game
Statistical Accuracy	★★★★	★★★★★	★★★★	★★★
Selection of Full Seasons	★★	★★★★	★★★	★★
Selection of Old-Time Teams	★★★★	★★★★★	★★	★★
Graphics	★★★★★	★★	★★	★★★★
Excitement Level	★★★★★	★★★	★★★	★★★
Strategic Scope	★★★★	★★★★	★★★★	★★★
Documentation	★★★	★★★★★	★★★★	★★★
Overall Rating	★★★★	★★★	★★★	★★

Some leagues are quite elaborate. The Royal Amateur Micro Baseball Organization, an eight-team aggregation based in New York City, has a weekly bulletin, monthly statistical report, a league championship party, and even a yearbook. Obviously, these are frills which can be customized to each group's wants.

Whatever way you choose to play, computer statistical baseball simulations can provide hours, or even years, of mental stimulation and pulse-pounding entertainment. And who knows? You may be the architect of the next computer baseball dynasty!

Books for Stat Fans

The ruling axiom of statistical baseball simulations is that the better you know the players, the better you will manage them. Watching and listening to actual games provides a lot of guidance about actual strategy, but reading is often the best way to get the big picture.

The annuals published by Street & Smith and *The Sporting News* provide excellent summaries of the previous season, along with pertinent statistics. Daily newspapers, such as *USA Today*, and the weekly *Sporting News* do the same for the season in progress.

A trio of quality paperbacks, issued annually, provide more sophisticated analysis for connoisseurs:

The Bill James Baseball Abstract (Ballantine Books) features exhaustive commentary by America's leading baseball scientist. It critiques every team and is loaded with unique studies and observations which genuinely illuminate the sport.

The Elias Baseball Analyst (Collier Brooks) is produced by baseball's most prestigious statistical service. It has every number you could possibly want or need.

The Scouting Report (Harper & Row) is an annual which exhaustively rates every major league pitcher and hitter. This is particularly useful for players of *Micro League Baseball*, since it provides information which helps select the right pitches for each moundsman to throw.

Of course, there are many, many more books and magazines devoted to the sport. These, however, form the basis of a stat game fan's basic library.

THE BARD'S TALE

Electronic Arts
Commodore 64
Disk; $39.95

Things are rotten in the once-peaceful town of Skara Brae. Mangar, an evil wizard, has the place in his power, and only a collection of the most powerful heroes and heroines can free Skara Brae from his devilish enchantments.

The Bard's Tale, billed as the first in a series of role-playing games called "Tales of the Unknown," chronicles the assault on Mangar and his minions. The computerist generates characters, forms them into adventuring parties, and challenges the monster-filled town and the even deadlier dungeons beneath it.

The specific goal in *The Bard's Tale* is to find Mangar and compel him to release Skara Brae and its citizens from his thrall. Beyond this, however, the program's wide-open construction gives it more depth and, consequently, greater replayability than adventures which are tightly tied to a central plot.

The path to Mangar is not linear. There are no clues to gather and puzzles to solve as such, though Skara Brae does have its share of mysteries. Before the gamer can confront the arch-mage, it is necessary to develop characters powerful enough to penetrate the hordes of crazed creatures which protect the villain.

As in such non-electronic role-playing games as "Dungeons & Dragons," characters begin life in *The Bard's Tale* in a virtually powerless state. Contact with some of Skara Brae's scarier residents often sends such low-level stalwarts to early graves. Characters increase their powers and abilities by gaining experience and finding useful magical items. Experience comes primarily from fighting and defeating hostile parties of monsters, and there's no shortage of opportunity for such encounters in *The Bard's Tale*.

The race and class of a character have a major impact on the construct's abilities. And elf, for example, does better than a human as a magic-user, while a dwarf excels in combat. There are seven possible races, including human.

Each character is rated (3-18) in five separate traits: strength, intelligence, dexterity, constitution, and luck. A high intelligence helps a mage progress faster and do more at each stage, while high dexterity may give a Warrior the advantage of striking the first blow in battle.

There are 11 possible professions, each of which has a unique set of advantages. While a Warrior or Paladin leads the way in armed combat, Bards have a selection of songs which provide magical aid, and Rogues can hide in the shadows and disarm potentially lethal traps.

Magic-users are subdivided into four distinct classes. Conjurers deal in the creation and manifestation of real things, such as fire. Magicians can affect physical objects and do such things as enchant swords and make walls disappear. Sorcerers create magical illusions, a talent so powerful that only experienced charac-

ters can qualify for the profession. Wizards summon supernatural powers. Although an adventuring party is basically limited to six members, a Wizard can add a seventh in the form of an imp, undead creature, or powerful demon.

The magic system is based on spell points. Each spell has a cost, and a mage can cast the ones he or she knows as many times as desired until spell points are exhausted. Unlike some other contests of this type, the points regenerate during the course of an adventure, so gamers won't find it necessary to hoard their magic power for emergencies.

The armchair adventurer controls a party with the keyboard. The I-J-K-L grouping governs movements, while other commands permit characters to take or drop objects, attack or defend, and perform other similar activities.

The self-prompting combat system is silky smooth. When a party meets some monsters and decides to fight, the program asks what each character intends to do in that round of the battle. The possible choices are listed as a menu, and the computerist simply pushes the appropriate key to make a selection. When all party orders are confirmed, the screen reports how each hero and creature actually fared.

The adventure gamer views the action in first-person perspective. The buildings and monsters are depicted in reasonably detailed color drawings, and there are deft bits of animation. The title sequence, which shows a bard singing a song of heroes in a tavern, is especially attractive.

There isn't a lot of sound for a game whose title contains the word "Bard", but the simple melodies are a welcome bonus after hundreds of mute quest programs.

If *The Bard's Tale* has a fault, it's that designer Mike Cranford and Interplay Productions have embraced the rigorous approach of many non-electronic role-playing campaigns a little too enthusiastically. The lives of characters are breathtakingly fragile, and it takes a long time to guide a character to a high level of power.

Although the documentation provides lucid information about every game-system and the overall routine of play, many aspects are deliberately left vague so that players must learn from experience. All too frequently, such knowledge is gained only at the cost of several characters' hides.

Comparison with the great role-playing computer titles of the past, especially *Wizardry*, is inevitable. *The Bard's Tale* is five years newer than Woodhead and Greenberg's classic, and benefits from numerous improvements in hardware and software which have occurred since 1981.

If you're hunting for easy victories and mindless bashing, look elsewhere. But if you like an intense mental challenge of a deadly and beautiful fantasy world, then *The Bard's Tale* is a perfect choice.

Electronic Arts, 2755 Campus Drive, San Francisco, CA 94403 (phone: 415-571-7171). *—Arnie Katz*

HERO OF THE GOLDEN TALISMAN

Mastertronic
Commodore 64
Disk; $9.99

Mastertronic's line of bargain-priced software frequently furnishes the best evidence of the difference in temperament between British computer gamers and their Colonial cousins.

Americans prefer their action games heavily spiced with strategy. The British market, dominated by young teenage male players, favors animated action games full of rooms and treasures which test reflexes to the utmost.

Despite the inappropriate cover art, which shows a private eye knocking out a thug, this is a straightforward action-adventure with fire-breathing dragons, evil wizards, and the seemingly inevitable magic talisman. The computerist must recover all five pieces of this amazing artifact while a swarm of electric butterflies makes existence precarious.

The documentation, several cuts above Mastertronic's previous standard, segments the dungeon into an alphanumeric grid. The instruction booklet actually lists every object in the game, where it can be found, and the sequence in which they must be collected. Unfortunately, it isn't much fun playing this type of game with an open booklet in front of you, and most players will be able to work out the proper order of activities on their own.

On the other hand, most users would probably appreciate help in figuring out how to utilize objects once they are acquired. The only reference to using the spacebar to activate objects is found in small type on the back of the package. Such an important detail should be mentioned more prominently.

Some explanation of the ratings displayed on the screen would have been a good idea, too. "STR" and "AIR" are fairly obvious labels, but what is "SC"?

The graphics are quite nice, especially the figure animation of the player's onscreen character. When he dives into the water, for example, the little adventurer tucks himself into a



Hero: *nice graphics, maddening audio.*
READER SERVICE NO. 232

protective ball to cushion the impact. The audio, alas, is positively maddening. Although no mention is made of it in the instructions, a siren was constantly going off during play. Clicking the action button generally stopped it, but seconds later it was wailing away again. If designers insist on placing horns, whistles, and sirens in their games, their use should be minimal. It's even better if the documentation explains the significance of all the nerve-frazzling noise.

The most important element in this type of program is the play-action, and it's much too tight in *Hero of the Golden Talisman.* The character frequently double-jumps on a single push of the button, and invariably slips off rocks when he starts to jump too close to the edge.

Hero of the Golden Talisman has some appeal for young action gamers, but more mature ones will probably find other programs less frustrating and more stimulating.

Mastertronic, 7311-B Grove Rd., Frederick, MD 21701 (phone: 800-368-9900). *—Bill Kunkel*

QUAKE MINUS ONE
Mindscape
Commodore 64
Disk; $29.95

Oil up the joysticks, computerists, this is one heavy duty entertainment program. Warren Foulkes and Mike Singleton's *Quake Minus One* is a great action-strategy contest with wonderful graphics and an excellent control system to make it all work.

The near-future plot centers on the Titan power station, a computer-run undersea complex. Drawing energy from the planet's core, Titan feeds power to a totally dependent high-tech world.

A metaphorical monkey wrench is flung into the gears when the Robot Liberation Front stages a terrorist raid on Titan. As the game begins, the RLF has sabotaged the station's computers, threatening a massive earthquake.

The government techies strike back, and retake the Hermes, one of the five computers which run Titan. Using Hermes' armed mobile units, the player must capture or destroy the other four computers.

The tactical display is the player's link to Hermes. The top half of the screen is devoted to the view screen, while the bottom contains a collection of gauges, clocks, and indicators.

The joystick-driven control scheme is quite ingenious. The player toggles from mode to mode simply by moving the cursor to the appropriate icon. Certain icons trigger entire submodes (Thrust, Static, Weapons, Junction, Repair, Command, and Emergency Command), which can then be accessed.

The tactical display includes a precise "you-are-here" map of the many roads and junctions comprising the Titan complex. Black dots indicate the RLF has control of the junction, while those under the player's sway are shown in white.

Weapons include mines, torpedoes, lasers, missile pods, fireball guns, ionic blasters, and two kinds of shields. Some of these weapons destroy, while others simply disable. Effective weapon selection requires considerable study and practice.

The player switches control from mobile unit to mobile unit in a frantic effort to retake junctions and reach the RLF-controlled computers: Zeus, Poseidon, Vulcan, and Ares, all of which are, of course, similarly equipped.

The graphics are excellent. Each structure is carefully rendered so that its shape is instantly recognizable by the computerist.

The game's documentation is pathetically inadequate. It is astonishing that Mindscape could have produced such a large booklet that explains so little. The 16-page rulebook teases the player with allusions to capturing a renegade computer instead of blowing it to atoms, but never discusses the mechanics of doing so. There is nothing in the rulebook to explain the tremendously complicated steering system, and accessing the repair mode is a prolonged exercise in frustration.



Quake: *an ingenious control scheme.*
READER SERVICE NO. 233

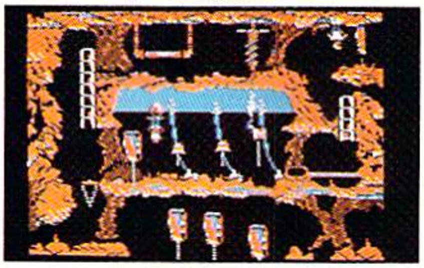
Far more serious, however, is the lack of correspondence between game and instructions. The icon representing the plasma shield, for example, is printed upside down in the documentation, rendering it unrecognizable. A game as sophisticated and complex as *Quake Minus One* must be fully explained.

Documentation aside, *Quake Minus One* is a masterpiece. It possesses all the shoot-em-up "juice" any joystick commando could want.

Mindscape, 3444 Dundee Rd., Northbrook, IL 60062 (phone: 312-480-7667). *—Bill Kunkel*

THE GOONIES
Datasoft
Commodore 64
Disk; $29.95

Several years ago, the entertain-



The Goonies *is good enough for us.*
READER SERVICE NO. 234

ment software industry went bonkers over movie licenses. Computer game publishers acquired good and bad ideas alike in a mindless quest for success by association.

Unfortunately, the software companies concentrated their time and energy pursuing "hot tie-ins," and not enough on turning such licenses into computer programs. Some promising movie properties became dreadful games as a result of slipshod execution, while the concepts for others should never have escaped the brainstorming sessions. Most of these releases shared a common bond: abysmal failure.

In the wake of jokes about computergame versions of such unlikely movies as *Kramer vs. Kramer* and *The Marathon Man,* the software industry pulled back its singed fingers and vowed to forget the world of film.

As everyone knows, there are fashion cycles in computer software as in most other aspects of popular culture. Recently, several companies have begun rethinking that posture. Activision's success with *Ghostbusters* and Simon & Schuster's *Star Trek* have shown that the right property, creatively handled, can be both aesthetically and commercially viable.

The publisher which has enjoyed the most consistent success, albeit on a somewhat more modest scale than the previously cited examples, is Datasoft. The icebreaker was *Bruce Lee*, a multiscreen action-strategy contest. *Conan the Barbarian* and *Zorro*, both in the same style but with even more mental challenge, have followed up on this initial success.

The Goonies, one of the first titles released since the company's management shakeup, represents a new wrinkle on that established formula. Players journey through eight screens, following the plot of the movie to a fault. There's even a sequence involving an octopus which was cut from the film.

Each playfield is an action puzzle. The player must deduce which onscreen object goes where, and then employ two onscreen goonies to perform the appropriate action.

The first scenario takes place at the home of the infamous Fratellis, the villains of the piece. Both goonies must escape to the caverns underneath the old place, while avoiding the ever-present Mama Fratelli. A quick look at the doll house-style cutaway shows a printing press in the attic, a chair on the top floor, and a water cooler and fireplace on the main level. The user toggles back and forth between the two goonies by hitting the action button. The gamer must get one goonie to move the chair under the attic entrance in order to reach the printing press, which spews funny money out a side window. As long as the bogus bills rain down, Mama F will be sufficiently distracted to allow the second goonie to dump the water cooler into the fireplace. This opens a secret entrance to the underground caves to facilitate the escape.

The action continues with seven screens full of falling sandbags, secret slides, vultures, skull mountains, an octopus, a secret cove, and a treasure-laden pirate ship.

The sound and graphics, while not groundbreaking, are nonetheless quite charming and more than adequate for this unassuming and surprisingly enjoyable game. Each object is distinctly delineated, and music mavens will enjoy the perfunctory rendition of "Good Enough" while the credits roll.

Software Creations, 19808 Nordhoff Place, Chatsworth, CA 91311 (phone: 818-886-5922). *—**Bill Kunkel***

SWORD OF KADASH

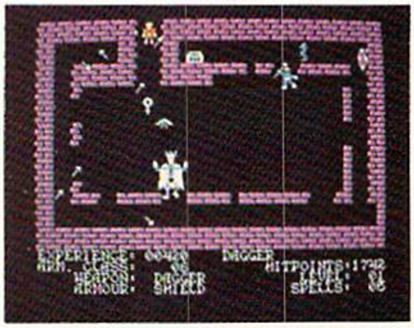
Penguin Software
Commodore 64
Disk; $34.95

Sword of Kadash is a graphic adventure in which the user-surrogate searches for treasure, magical objects, and weapons while moving across a dungeon landscape depicted in overhead perspective. There are magical spells, traps, and all manner of wandering monsters.

Talk about déjà vu!

Despite the occasional "Arabian Nights" trappings, *Sword of Kadash* plays exactly like a poor relative of the *Apshai* clan. In fact, this program's weakest elements are those which distinguish it from the classic Epyx series.

Although a wide range of weaponry is available—dagger, morningstar, axe, sword—all are shown as a series



Kadash: ***1001 Arabian "mights."***
READER SERVICE NO. 235

of shooting darts. The documentation explains: "This allows you to inflict damage on a monster without direct contact." Then what's the point of having different weapons? True, a sword does more damage than a dagger, but the strategic advantage of projectile over hand weapon is surrendered to a crude coin-op sensibility. One of the great strengths of the *Apshai* games is that each situation calls for a different weapon.

The control system is original, but it really isn't very well constructed. *Sword of Kadash* limits user options other than movement to the fire button and spacebar.

The graphics are acceptable, though far from state of the art. This is not altogether surprising in a game originally copyrighted in 1984, but perhaps the Commodore edition should have gotten some sprucing up.

Very little is done with the Arabian possibilities, either. Why, for example, are we playing with "swords" rather than "scimitars"? *Ali Baba* (Quality Software) utilizes the visual potential of the exotic locale much more successfully.

Sword of Kadash is not a bad game, it is simply a step below many titles in its category. For those who've played the mylar off their *Apshai Trilogy* disks, however, *Sword of Kadash* offers some fresh challenges.

Penguin Software, 830 4th Ave., P.O. Box 311, Geneva, IL 60143 (phone: 312-232-1984).

*—**Will Richardson***

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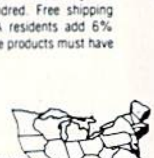
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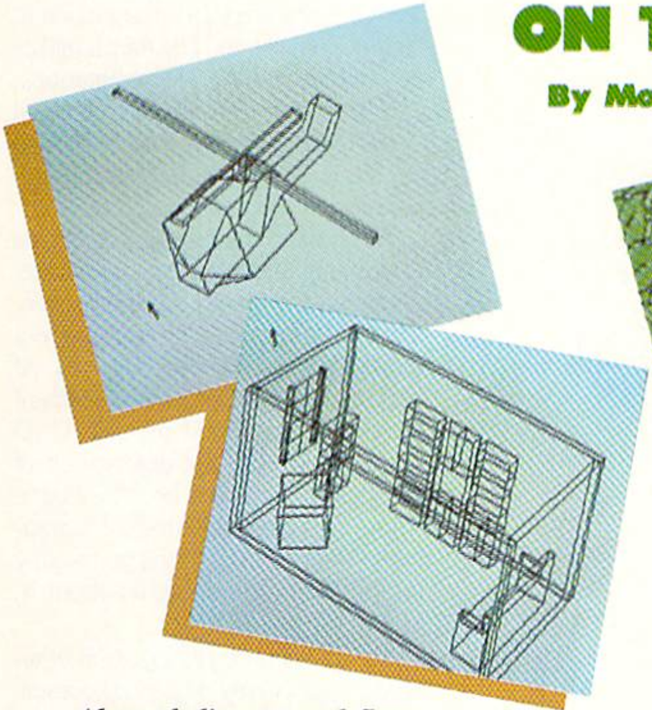
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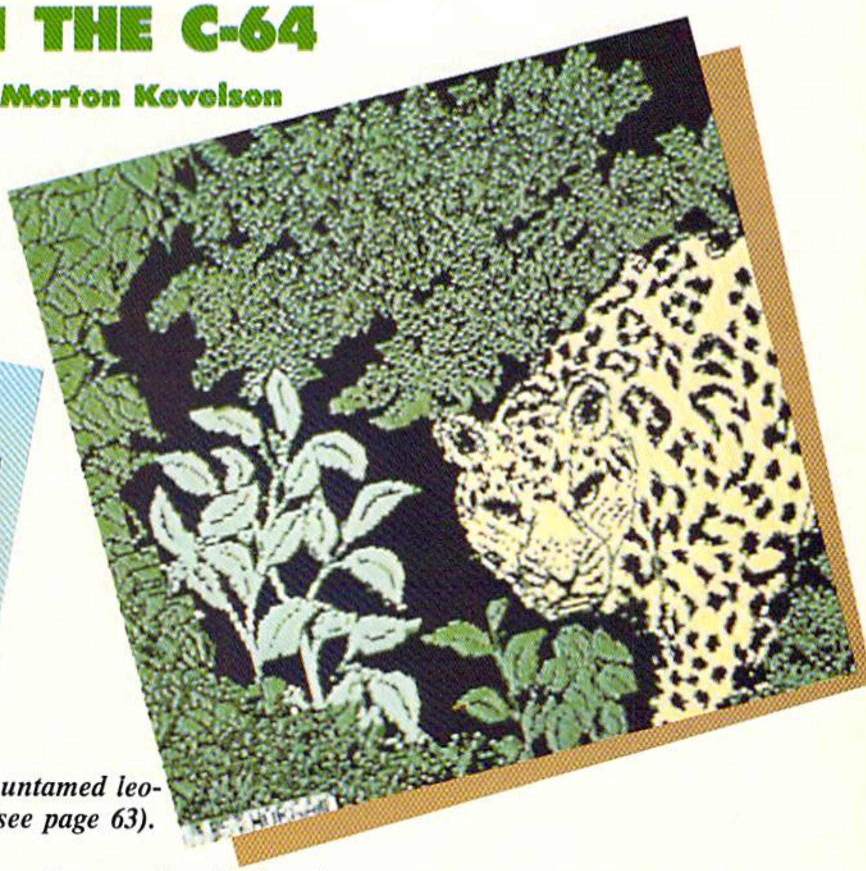
Reader Service No. 267

CAD graphics has long been an elusive goal for the C-64. We now have some commercial packages which have taken the first firm steps towards attaining this lofty ambition. Although the results look promising we are not yet convinced that a true CAD system can be implemented on an eight bit, 1 MHz computer.

COMPUTER AIDED DESIGN ON THE C-64

By Morton Kevelson





Above: helicopter and floor plan designed with CAD GEM *(see page 62). Right: caution is in order as an untamed leopard roams through the* Flexidraw *forest (see page 63).*

An essential part of the engineering process is the translation of physical ideas onto paper. The end product of all engineering activity is the manipulation of matter and materials in a beneficially constructive manner. In simple terms this means the creation of a physical product which we may use for our benefit. An essential step in the manufacturing process is the production of a detailed set of drawings which accurately describe the end product. These drawings must contain enough information to guide the parties involved through the various steps of the manufacture of a product.

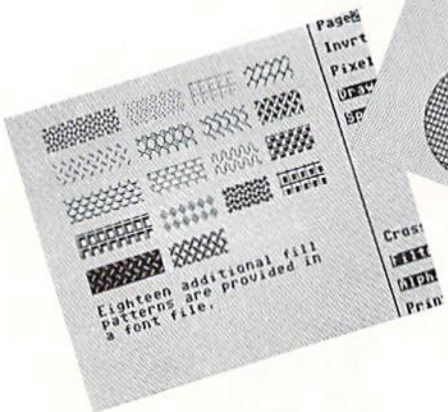
The traditional method of creating these engineering drawings requires the time consuming manual application of transcriptive instruments to a durable drawing medium. These drawings are normally revised several times during the development process before the final design is released for production.

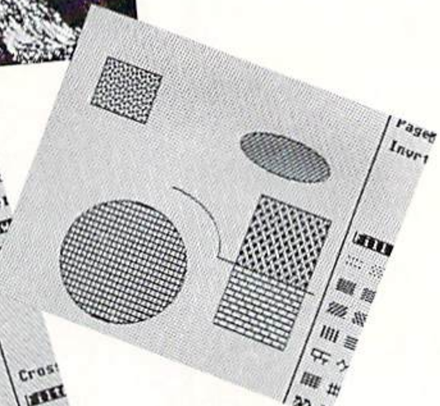
As with many time- and labor-intensive tasks, the computer has been sought out to alleviate the tedium. Computer Aided Design (CAD) was developed as soon as sufficient computational power was available to handle the complex tasks. A full featured CAD system can greatly speed up the design process while reducing errors and enhancing flexibility. Drawings may be rapidly revised, scaled, and otherwise modified to meet the varying requirements of different manufacturing tasks. Multiple layers or overlays can be updated and combined to form a complex composite drawing. The most powerful systems include extensive database facilities to organize the materials acquisition associated with the final construction.

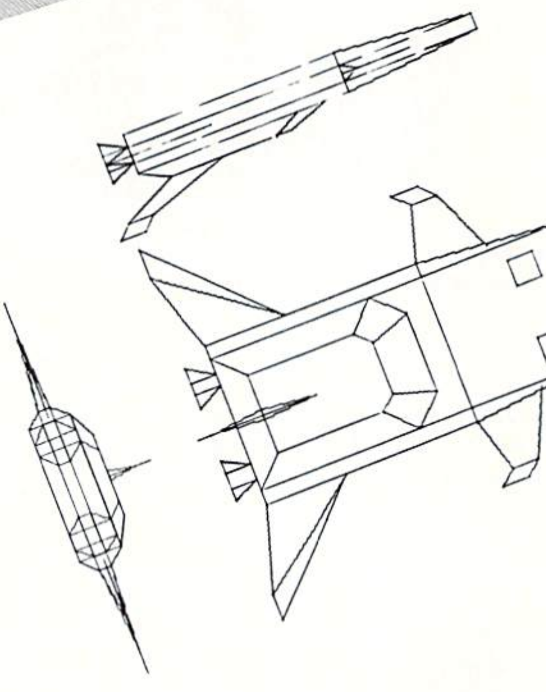
As microcomputers increased in power and dropped in cost, more and more applications were transferred to them. What was formerly the realm of the mighty mainframe is now part and parcel of the most modest minicomputers. We are also well aware that the dividing line between minicomputer and microcomputer is no longer clearly defined.

As veteran users of the C-64 we have become somewhat jaded by what may be done with our modestly priced machines. We have seen text









From top: ***(1) Wayne Schmidt's Irish Spring may be visited on the* Flexidraw *disk excursion tour. It is shown here on the* Pen Palette *work palette. (2) 14 fill patterns are built into* Flexidraw *and available off the menu. Any of the Commodore characters can also be used as a fill pattern. (3) More fill patterns on* Flexidraw *disk. (4) Commodore 1520 Plotter dump of* CAD-3D *photo.***

processors, spreadsheets, and database packages which hold their own against the best which the eight bit (and some of the sixteen bit) micro world has to offer. It was just a matter of time before CAD applications were tackled as well.

In the following pages we present reviews of four drawing packages for the C-64. Each of these incorporates many CADlike features. Three of these employ the CAD designation in their nomenclature. The fourth makes no pretense of CADlike inclinations. Not surprisingly, this more traditional C-64 drawing package format is more atuned to the capabilities of the machine than the rest.

We applaud their designers' efforts in bringing these products to market. Although the results are impressive, the CAD promoted programs are a long way from full CAD systems. At best they are CADlike simulations of some features found on true CAD systems. A more apt description of these packages would be Wire Frame Three Dimensional Image Manipulator (WIFTDIM). Don't go looking up this term or writing us about it, as we just made it up.

A wire frame representation of an object depicts only edges and corners of an otherwise solid body. Thus a cube is shown as a collection of twelve lines joined at eight points. WIFTDIM images are fundamentally different from conventional bit map images. In the common bit map, both high-res and multicolor, what you see is what you've got. If you wish to reveal a different aspect of a displayed object then you must manually redraw the image. In contrast, the WIFTDIM stores each image as a table of points and connecting lines. Each point is described by its horizontal, vertical, and depth position in space with relation to an arbitrary but clearly defined location in your computer's memory. This gives the WIFTDIM the singular capability of displaying varying views of an object without requiring the user to redraw it.

When you are using a WIFTDIM the video display screen becomes a plane upon which the current view of the object is projected. As the ob-

PROGRAMMERS TAKE NOTE

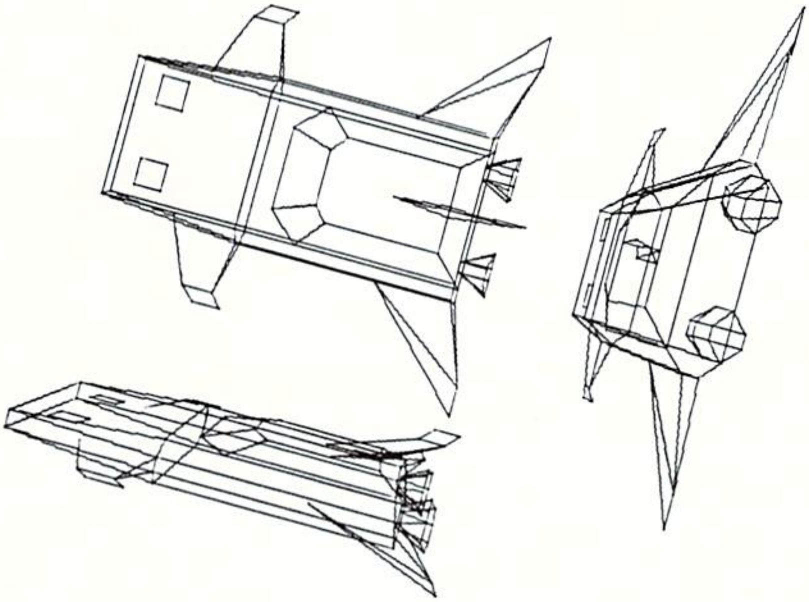
If you are interested in programming and the type of graphics discussed above, consider *Computer Aided Design for the C-128 and C-64* by Werner Heft. This collection of BASIC programs is published in Germany by Data Becker and in this country by Abacus Software. The routines are designed for the Commodore 64 equipped with a *Simons' BASIC* cartridge or a Commodore 128 and BASIC 7.0.

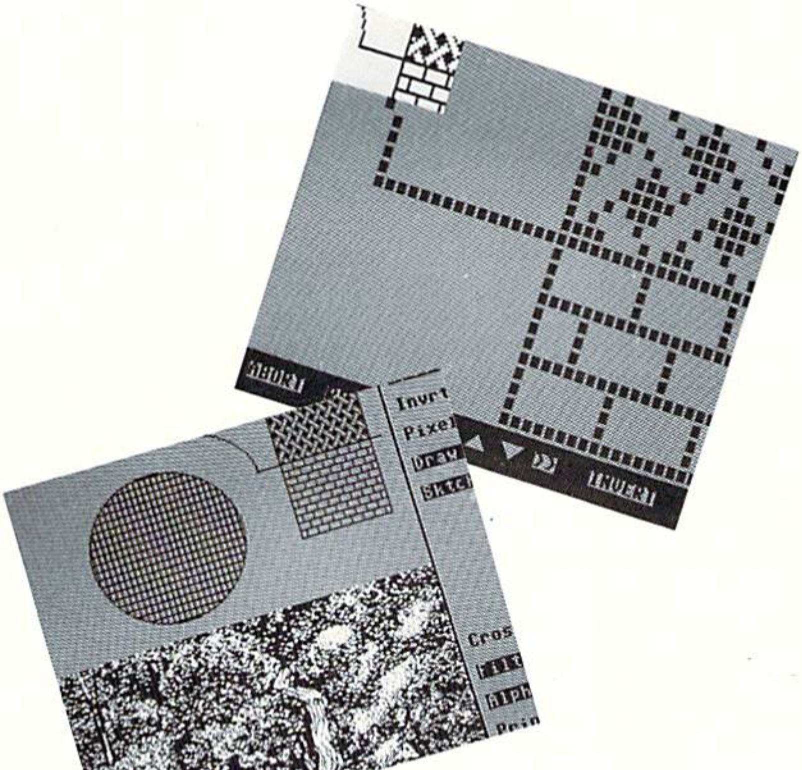
A step by step approach is used to present the fundamentals of geometric drawing with the computer. The program modules are designed to work individually or as an integrated whole. The final result is a functional WIFTDIM.

The bulk of this 310 page, $19.95 volume is devoted to the programs themselves. There is a bare minimum of text which guides the reader along while tying the whole thing together. The linking text is well-sprinkled with witicisms to keep the reader alert. The programs are well-structured for easy study. As with all Data Becker/Abacus books, the hand of the translator is evident.

ject is rotated, or the viewing plane is moved (it really does not matter which, as it is all relative anyway), different views of the object appear. What is most impressive about this process is not apparent to the user. The act of manipulating a three dimensional object in space is mathematically intensive requiring numerous detailed calculations. This process is no mean feat for a 64K, 1 MHz computer.

In light of all the demands that CAD in general and WIFTDIMs in particular place on the computer's resources, some compromise is necessary on what features will be included in the package. We now take a close look at how these developers have chosen to tackle the problem.





From top: *(1) Another 1520 Plotter dump of a* **CAD-3D** *photo. (2)* **Flexidraw's** *zoom mode sports an original size window to let you know just where you are. The alignment grid is available in zoom mode as well. (3)* **Flexidraw's** *dual screens and split screen mode gives the artist much-needed workspace. Horizontal and vertical splits are illustrated opposite Wayne Schmidt's detailed design.*

CAD-3D
IHT Software
Commodore 64
Price: $39.95

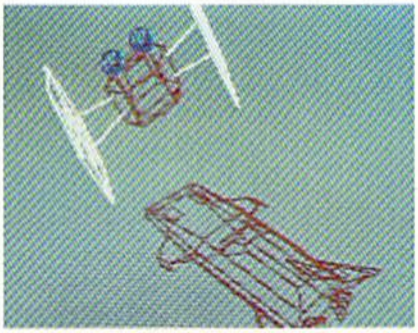
There are several ways of displaying a three-dimensional object on a two-dimensional plane. Orthogonal projection is the most common approach for engineering applications. This method maintains all viewing lines perpendicular to the plane of projection. The result is dimensional accuracy in the projections of all object surfaces which are parallel to the viewing plane regardless of the distance to the observer.

Orthogonal views are generally presented as a triad showing the front side and top of the object. Very often these will be accompanied by several additional views of key surfaces which are not parallel to the viewing plane. These surfaces appear distorted in the three basic views. However, if their angle is known, their true dimensions may be calculated from the basic views. Placing these views on auxiliary projection planes allows the objects' true dimensions to be presented.

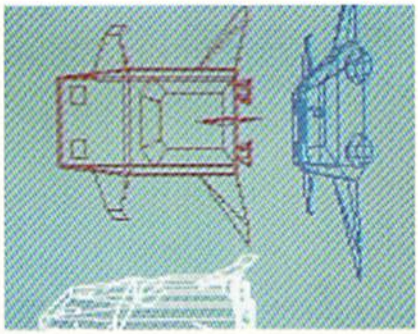
Although orthogonal projection is highly desirable from an engineering standpoint, it may be difficult to visualize the appearance of an object from these views. Several other drawing techniques have been developed to better stimulate the imagination of the human observer. The most effective of these is the perspective projection. The principle of perspective drawing is simply to size the view of an object inversely proportional to its distance from the observer. The apparent convergence of parallel railroad tracks into the distance is a well known example of this phenomenon.

CAD-3D provides the option of both orthogonal and perspective projection for viewing stored objects. This makes it visually simple to keep track of objects during the creation process.

The origin of the *CAD-3D* coordinate system is in the center of the video display. The x coordinates are laid out along the horizontal axis with increasing values to the right. The y coordinates are along the vertical axis with increasing values toward the top of the screen. The z coordinates are along a line perpendicular to the surface of the screen increasing toward the viewer. Both positive and negative values may be entered.



An imminent CAD-3D *confrontation.*
READER SERVICE NO. 236



Three views of object in multicolor mode, with perspective turned on.

The two cursors which are displayed on the screen may be positioned using either the keyboard or joystick. The bottom line of the screen displays all three coordinates of the cursors as well as the current operating mode.

Objects are created by adding point pairs and a corresponding connecting line to a data matrix in the computer's memory. Adding a line is a three-step process of positioning the cursors, inserting a space in the matrix, and setting the connecting line. All data entry is accomplished by positioning the cursors till the desired values are displayed. Data points may be reviewed by stepping through the matrix redisplaying their values on the screen. There are no provisions for direct entry of numerical data or for listing the stored data values to the printer.

The data matrix may store up to a total of 2000 lines. The 3-D display field, or size of the object matrix, is 256 elements in all directions. That is, the x, y, and z coordinates may range from −128 to +127. The actual displayed image is limited to 256 horizontal by 192 vertical pixels on the C-64's high-resolution screen.

The user may choose between the C-64's high-resolution or multicolor display screens. In hi-res mode the display area is limited to the number of pixels specified above. In multicolor mode the entire display screen is used, although cursor movement is still in increments of the hi-res pixel size. Hi-res displays are single color. Multicolor displays can have up to three line colors. All colors, including border and background, may be set by the operator.

Objects created with *CAD-3D* may be translated along any or all of the three axes. Translation resolution is one unit. Translations are limited to the ranges specified above provided that none of the stored point values exceed these same limits. Rotation about any or all three axes is also possible. The rotation range is from −180 to +170 degrees and its resolution is 1 degree 24 minutes of arc.

All translations and rotations may be either absolute or relative. In the case of the former the motion is set and executed once. In the case of the latter the setting may be repeatedly applied with a single keystroke to incrementally step the position of the object. All movements may be temporary for preview purposes without affecting the data matrix. Permanent movements recalculate the coordinates stored in the object matrix in memory.

The object matrix may be partitioned into two parts. These "operative fields" may be individually or jointly displayed. Any consecutively stored set of lines may be designated as an operative field. As with all *CAD-3D* operations, the partition process is visually enhanced by positioning the cursors at the line endpoints while defining an operative field.

Translation and rotation may be performed on the displayed field without affecting the undisplayed field which is still in memory. Operative fields may be saved and loaded, allowing complex

objects to be constructed from primitive elements.

CAD-3D objects files are not saved as C-64 bit maps. Instead the actual point and line data is stored. The format of the object files is not provided, precluding the use of the data in your own programs.

A special save option lets you store the current hi-res screen as a bit map in *DOODLE!* file format for manipulation by City Software's graphic package. However, *DOODLE!* files may not be loaded back into *CAD-3D*.Once in bit map format, images may be displayed in your own BASIC programs.

A library of seven complex, well-executed images is included on the disk. Although these are very good for showing off the package's capabilities, we felt that a collection of primitive object building blocks would have been useful. If you do plan to create a library of primitive objects, note that *CAD-3D* lacks a scaling feature. Thus any objects which are to be combined must be designed to fit.

Hardcopy may be generated on the Commodore 1525/MPS-801/MPS-803 and 1526/MPS-802 printers. Any dot matrix printer with an interface that emulates the Commodore 1525 may also be used. Images thus created are simple bit map dumps of only the hi-res display. Objects stored in memory may have dimensions which exceed the display area, in which case only the visible display will be dumped.

The best hardcopy results are obtained with the Commodore 1520 Printer Plotter. This nifty, now extinct peripheral may still be available from many dealers. We obtained ours at a bargain basement price—$50 from a local Toys R Us. Plotter dumps have equal vertical and horizontal proportions. The entire matrix is dumped, included sections not visible on the display screen. The multicolor display may also be plotted using all three pen colors. There is no text capability in *CAD-3D* other than assembling characters as any other object.

The *CAD-3D* manual gives complete instructions which are brief, to the point, and with every evidence of having been translated from a foreign tongue. Some experimentation with the computer and the manual will be required to derive the true intent of some of the unintentionally cryptic instructions.

CAD-3D is suitable for instructional purposes. It is an excellent aid for illustrating the spatial relationships among simple objects. The drawing, translation, and rotation of images is fast enough to maintain the interest of the viewer.

CAD-3D is supplied on a copy-protected disk with a 30 day replacement warranty. No provisions are made for obtaining a backup copy.

IHT Software, 2269 Chestnut Street, #162, San Francisco, CA 94123 (phone: 415-441-1607).

CAD GEM
Micronic Interface Technologies
Commodore 64
Price: $79.95

This package is billed as a Computer Assisted Design Graphic Element Manipulation System. From this minor mouthful is derived the acronym by which it is known. *CAD GEM* is a WIFTDIM with broad capabilities.

Objects stored in *CAD GEM's* data matrix are displayed on the full C-64 high-resolution screen. The coordinates axes are centered about the visible screen. The x axis is horizontally positioned with increasing values to the right. The y axis runs vertically with increasing values toward the bottom of the screen. The z axis is perpendicular to the screen with increasing values away from the viewer. Although the y and z axes are reversed from the conventional orientation, the resulting set still forms a right handed coordinate system.

All of *CAD GEM's* operations are menu-driven. Selections are made by positioning the screen cursor over your choice and pressing the button on your input device. *CAD GEM* accepts input from the keyboard, joystick, trackball, Koala Pad, paddles, or light pen.

The first time you use *CAD GEM* you will be automatically guided through an installation procedure for selection of your input device and printer. This routine will be bypassed for all subsequent LOADs. However, you may rerun the setup program when required. Printers presently supported are the Commodore 1525, Gemini/Epson, Okidata, and C.Itoh 8510. You should also create some backup copies before your first use with the MASTER.COPY routine on the disk. This will let you create three copy-protected backup copies of the original copy-protected program disk.

CAD GEM's operations are driven from two main menus. Submenus display options as required. Objects are entered using the Edit menu. Starting from scratch you first enter a set of points either from the keyboard or by positioning the cursor using your input device. Once point entry is complete you must immediately set at least one line. Failure to do so will cause the program to forget your data. An orthogonal projection of the lines and points is displayed as they are entered. Line and point data may be listed to the screen or printer in a convenient tabular form.

Object files may be stored on disk for later recall. The distribution includes a large number of basic geometrical constructs and primitives. These include many of the basic geometrical shapes such as spheres and cylinders as well as a collection of electronic circuit symbols. Up to 100 primitives may be brought into memory at one time. Each of these modules may be independently manipulated with *CAD GEM's* translation, rotation, and scaling capabilities. Once the primitives have been fitted, the entire group may be manipulated as a single object. The individual character of the primitives may be maintained for as long as necessary. Complex objects can be saved as a collection of primitives in a single file or they may be combined into a single group.

Manipulation of primitive or objects is done in View mode. The image display, in this case, is a perspective projection of the composite object. Perspective may be adjusted by a combination of scaling and shifting of the object towards or away from the viewer. The bit map of the displayed screen may be saved to disk or dumped to the printer. Points which are out of range of the screen display will not be saved or printed as part of the bit map. Keyboard entry of text onto the bit map screen is possible immediately before performing a bit map dump.

Internally, the *CAD GEM* coordinate system spans the entire range of BASIC's floating point number set. This allows for the creation of huge objects at enormous distances from the viewer. In practice you must remember to balance the size and location of objects with the nine digit precision of the C-64's floating point math routines. The actual limit of object detail is a total of 750 points.

We found a number of quirks in the *CAD GEM* system during our tests. According to the preliminary manual all rotations are performed about the origin of the coordinate system. An appendix in the same manual states that rotations are performed about a point calculated from the average position of all object points. It turned out that the appendix was correct. We can see the value for rotations about the object "center" in view of the fact that objects may be shifted some distance from the origin. However, rotation about the origin would be of considerable utility during the initial object creation process. Rotation about the object center tends to generate intuitively unpredictable results.

The object editor had some awkward quirks as well. The edit lines function treated the first point in the data matrix as point number zero. All other edit functions considered this as point number one. The edit points function also reversed the order of entry of data points as they were added to the matrix.

A large number of the quirks we encountered were due to disagreement between the preliminary manual and the way the package actually worked. We expect this to be cleared up in the final version, although current shipments still include the preliminary documentation.

CAD GEM gives the impression of a powerful program which is awaiting completion. This opinion was somewhat bolstered by Computer Tools' "Tool Swapper." This newsletter which is intended to be "an ongoing series of semi-bi-directional releases" is being sent to all registered owners of *CAD GEM* and the company's other C-64 product, the *Graphic Screen Exporter* (a C-64 bit map conversion package). The January 1986 issue included some useful information on *CAD GEM*, including its object file data structure. Several intended enhancements of the package were announced as well. These include hidden line removal, on-screen text, formula input of object data, manual revision, and a plotter support package.

CAD GEM is a powerful package operating within the constraints of the C-64. It should be suitable for creating preliminary designs of moderately complex structures. We await with some interest the results of the final updates to this package.

Micronic Interface Technologies, Computer Tools Division, 159 West 53rd Street, Suite 15B, New York, NY 10019 (phone: 212-245-5718).

CADPAK-64

Abacus Software
Commodore 64
Price: $39.95

CADPAK-64 is a high-resolution bit map drawing package for the Commodore 64. It is a planar (or two dimensional) package, with images limited to the dimensions of the bitmap screen. *CADPAK-64* emphasizes the precise positioning of picture pixels on the drawing surface. It is unique among C-64 drawing programs in its ability to keep track of the physical dimensions of the object drawing on the display screen. Furthermore, this precise dimensioning will be transferred to paper to generate true scaled drawings.

Two versions of *CADPAK-64* are supplied with the package. These differ only with the choice of keyboard versus light pen as the input device. In either case you will have to supply your own keyboard or light pen.

The first step in using *CADPAK-64* is calibrating the package to match your printer. A dedicated sizing program prompts you through the procedure. This ultimately generates a small and large rectangle on your printer. You carefully ascertain the dimensions of these quadrilaterals using a ruler or other suitable implement. These values are then told to the computer, which fastidiously saves them to the program disk. Your choice of units is limited to inches or centimeters. Choose wisely, as all subsequent images will be scaled to this base unit (i.e., miles per inch, furlongs per centimeter, etc.). You will want to avoid needless repetition of this procedure, as the program disk is copy-protected. Just get it over with and place a write protect tab on the disk.

A wide range of printers are supported, including the Commodore 1525 and 1526, the Epsons and their lookalikes, the Okidata 92 and Okimate 10 (in black only), and the C.Itoh 8510. The program's opening screen includes a message announcing a plotter version of *CADPAK-64*. This has not yet materialized.

Every time you start up *CADPAK-64*, or whenever you start a new drawing by clearing the screen, you

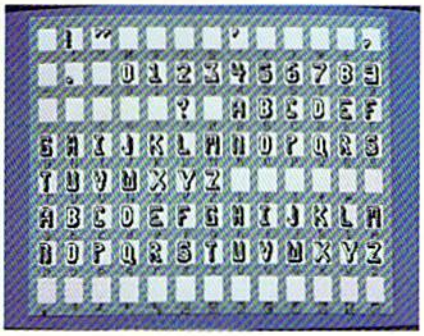
will be prompted to enter your current dimensions and scale. For example, your dimensions may be in yards and the scale may be 10 yards per centimeter. The working dimension of the current drawing may be anything you like. From this point on *CADPAK-64* will automatically keep track of your cursor position in the specified units. The lower left hand corner of the screen is the origin of the coordinates.

All of *CADPAK-64's* operations are menu-driven. The accompanying screen photograph shows most of the available operations. Selections are made by merely pointing with the light pen or hitting the first two letters on the keyboard. Some selections will lead to one or two submenus before completion.

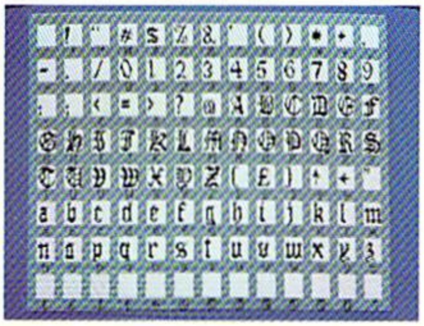
Although a draw option is available, it is not the way you will want to use *CADPAK-64*. Creating an image pixel by pixel tends to be a tedious and cumbersome process. Instead *CADPAK-64* is designed for efficient operation using its built-in geometric drawing functions. These span the range of the common shapes including circles, elipses (at any orientation), arcs (actually elliptical quadrants), lines (including rays and continuous segments), and rectangles.

The power of *CADPAK-64* lies in its built-in coordinate maintenance. The positioning and proportioning of the bit map screen are not left to purely visual selection. Instead the actual cursor position, in the selected units, is continuously available to the user by hitting the f5 key. This provides you with the cursor's absolute x and y coordinates, its relative x and y displacement from the previous cursor position, and the actual distance between these two points. All these values are in the units you selected at the start of the drawing (i.e., feet, meters, or whatever). These dimensions are scaled to the final hardcopy as calibrated on your printer and not to the screen. Thus circles which may appear flattened on the display will be properly rounded on the printer.

The cursor may be positioned either manually or automatically. The



CADPAK-64's *3-D font screen.*
READER SERVICE NO. 237



Olde English font screen. Customized fonts can also be generated.

manual method requires a two-step process. First there is a coarse positioning in eight pixel increments. This is followed by fine tuning the cursor position a single pixel at a time. You step through the process using either the CTRL key (CONTROL for C-128 and SX-64 users) or the button on the light pen. The operational status of this "accupoint" feature is signaled by the color of the screen border.

Automatic cursor positioning is selected by pressing the COMMODORE key. This lets you enter the cursor coordinates from the keyboard. You may specify either an absolute position or a relative offset from the previous cursor location.

The automatic scaling also supports a measure function. This allows you to place the cursor at any point on your drawing and set its location. You may then move to a second point on the drawing. The automatic readout will then inform you of the horizontal and vertical displacement between these two points, as well as the absolute distance between them. Of course all these dimensions are in the real units of your choice.

Several powerful drawing support utilities are built into *CADPAK-64*. Two complete drawing screens are directly available. A copy function al-

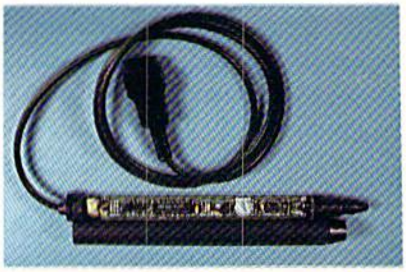
lows you to define an area on either screen and transfer it to any part of either screen. This may be a direct copy or a controlled copy. The copy controls include sizing, rotation in 90 degree increments, and mirroring of the copied block. Logical operations may also be performed on the copied image. These are equivalent to anding, oring, or exclusive oring the overlayed images. The option of copying with and without color is supported.

Although *CADPAK-64* is intended as a dimensioned drawing package, color support is available. This is limited by the C-64's high-resolution display mode to two colors in an 8 × 8 pixel cell.

Text may be placed anywhere on the screen using all of the Commodore characters. Alternate fonts or objects are available using the built-in font and object utilities. These let you create your own font or object sets for loading into the second screen. These custom fonts may be treated as text with the size under your control. You also have the option to use the object handler to place the text or object on the screen. This adds mirroring and rotation features to the placement of objects. *CADPAK-64* includes three fonts and one object file ready for your use. Object files and font files are treated identically by CADPAK.

The package includes a detailed manual with more than 80 pages of concentrated information. You may find it somewhat cumbersome at first, as this is primarily reference material. We suggest you carefully follow the three-chapter tutorial at the back of the manual. The disk includes several image files in support of the tutorial. Once you have learned the basic *CADPAK-64* operations, the remainder of the manual will be far more helpful. Overall *CADPAK-64* follows a very consistent set of procedures for all its operations. The package is well worth considering if your needs are for accurately dimensioned drawings.

Abacus Software, P.O. Box 7211, Grand Rapids, MI 45910 (phone: 616-241-5510).



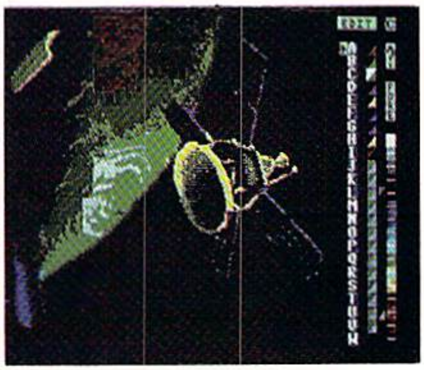
The Flexidraw light pen is loaded.
READER SERVICE NO. 238

FLEXIDRAW 5.0

Inkwell Systems
Commodore 64
Price: $149.95

We first looked at version 3.0 of the *Flexidraw* system in the November 1984 issue of *Ahoy!* We were well impressed with its performance then, just as we are now. Version 5.0 represents the latest release of this comprehensive light pen-driven graphics package. Many features have been added since we reported on the earlier version, far more than a mere two-digit increase in the version number would indicate. Thus we felt it would be worth our while to take a fresh look at its capabilities.

The package still includes Inkwell Systems' DT170 high-resolution light pen. This light pen, which represents the bulk of the package cost, is the most precise instrument of this type which we have encountered in the Commodore market. The accompanying photograph shows the complexity of the internal hardware of this deceptively simple package. The pen has a built-in pressure sensitive tip switch which may be used to signal the computer. This is an optically



Flexidraw's **Paint Palette** *from a viewpoint in low earth orbit.*

triggered switch with no contacts to corrode or wear out.

The package includes a double-sided 1541-formatted disk that is chock full of programs, support utilities, text fonts, clip art files, and sample images, with a total of only seven blocks free on both sides of the disk. As a first step you should back up the disk using the included fast copy utility.

Flexidraw is a high-resolution bit map screen drawing package. It includes many features which support both freehand sketching and precision manipulation of the bit map image. All the program's functions are accessed through an onscreen light pen-driven menu. This is a multilevel dynamic menu where the displayed functions automatically change to match the current operating mode. The menu only displays what is needed and conversely everything that is needed always seems to be displayed. Even the vertical dividing line between the drawing screen and the menu serves a purpose. It controls the width of the drawing brush.

The C-64 high-resolution bit map screen consists of 320 horizontal by 200 vertical dots or pixels. The *Flexidraw* menu steals 48 of these pixels, leaving a drawing surface only 272 pixels wide. The system more than makes up for this by letting the user link the two built-in drawing screens either vertically or horizontally. In this mode the left and right halves or the top and bottom halves of the two screens are displayed joined at the center of the screen. The identity of the individual work screens is maintained by using a different shade of gray for the screen background color.

This effectively extends the drawing surface to 542 dots horizontally or 400 dots vertically. Actually there is no limit to the size of the work surface using this technique. Completed screens may be saved to make room for new material. We consider this an effective response to the *Graphics Challenge* we presented in the October 1984 issue of *Ahoy!*

Most of *Flexidraw's* operations are controlled by the light pen. Some functions require the use of the keyboard. A handy overlay is provided for the function keys where the bulk of the keyboard operations reside. The remaining keyboard functions are primarily the CTRL key which may be used in lieu of the pen's tip switch and the left arrow key which is used to set points for some of the drawing functions. The RUN STOP key now activates the important "oops" or "undo" function for many of *Flexidraw's* operations. Of course the entire keyboard comes into play when you are entering text on the screen.

Flexidraw provides excellent support for precision operations. A grid mode restricts placement of pixels to 8 × 8 pixel character cell boundaries. A crosshair may be displayed on the screen for positioning at the pixel level while lining up with other screen objects. An effective zoom mode allows for dot by dot adjust-

ment while the original size image is displayed in an onscreen window.

Basic geometrical operations are supported. These include the drawing of boxes, circles, ellipses, and arcs or elliptical quadrants. Lines may be drawn point to point, continuously rubber banded, or fanned out from a single point. 14 fill patterns are built into the system. Many additional patterns may be created, since any of the keyboard characters can be used for this purpose. 24 additional fill patterns are included on the disk as a loadable character font.

Extensive text handling is provided with support for most of the C-64's full screen editor features. All the built-in Commodore characters may be used. Two additional fonts may be loaded in from disk. Eight standard size (8 × 8 pixel) fonts and two "Flexi" fonts are included on the disk. The "Flexi" fonts are custom quadruple sized (16 × 16 pixel) characters for elaborate text displays. A separate package, *Flexifont,* is available from Inkwell Systems. This program allows you create your own fonts and pattern fills for use with *Flexidraw.* This supplementary program disk also contains 33 additional font styles.

Flexidraw incorporates a comprehensive set of copy and paste functions. Although the operations have not changed from version 3.0, the nomenclature has. Paste operations are now done as test, with, and over. These correspond to logical exclusive or, logical and, and an exclusive or followed by an and. Thus two pastes in the same place using test will restore the original screen. Images copied to the scratchpad may be rotated or flipped in any combination before being pasted.

The copy operation is restricted to multiple character cell chunks. This permits the creation of symbol libraries or clip art files. These collections of symbols are designed to connect up when they are copied and pasted following the grid guidelines. Four of these image files are included on the program disk. These are collections of electronic, mathematical, and architectural symbols.

Full bit map printer dumps are included with *Flexidraw.* Supported printers include the Commodore 1525 and 1526 (currently the MPS-801/803 and the MPS-802) and the 1520 plotter. Other printers include the Epsons and their lookalikes, Okidata, and C.Itoh. Single size and quad size dumps are available. Remember the linked screens we talked about above. If you have a 1526, Epson type, Okidata, or C.Itoh printer, *Flexidraw* can automatically print two single size images side by side. The process may be repeated to generate hardcopy of as many vertically linked side by side images as you would like. Up to six of these screens will fit comfortably on a single 8½ × 11" sheet of paper.

The *Flexidraw* system lets you color in your high-resolution pictures using a separate *Pen Palette* utility. This program uses a unique and effective approach to adding color within the limits of the high-resolution bit map display. Remember only two colors are allowed within a given 8 × 8 pixel character cell.

Pen Palette works with a set of 23 "paint pots," each of which contains a foreground and background color pair. Images are saved in two parts, the basic bit map and a separate color file. The relationship of each paint pot and the cells which were painted with it is saved as well. This makes it possible to change the color of an entire screen area by changing the contents of a single paint pot.

If this all sounds a bit confusing, do not be concerned. An excellent tutorial based on five *Pen Palette* color images, which includes a final exam, provides a quick introduction to the system.

The *Flexidraw* system disk includes a collection of additional programs and utilities. These include:

A sprite editor and animator.

A display picture program which lets you put a light pen-driven arrow on the screen, suitable for lectures.

A light pen version of the *Follow Me* game.

A simple telecommunications program for transmitting *Flexidraw* images.

The Four Seasons, a quasi-animated display of Wayne Schmidt's *Irish Spring.* The colors of the leaves cycle through their seasonal changes while the spring waters flow down the hill.

As an added bonus, the basic *Flexidraw* machine language plotting routines may be accessed from your BASIC programs. These routines let you plot points, draw lines, and draw circles from within your BASIC programs.

Overall, *Flexidraw* is a very impressive package. Although its initial cost may seem high, it provides an excellent value for your dollar.

Inkwell Systems, P.O. Box 85152 MB290, 7677 Ronson Road, San Diego, CA 92138 (phone: 619-268-8792).

For Additional Information...

...on any of the products advertised or otherwise pictured in this issue of *Ahoy!,* circle the corresponding reader service number on the card located between pages 34 and 35.

COMMODORE ROOTS

NOW HEAR THIS

Making SID Sing—Part II By Mark Andrews

The Commodore 64, despite its plain looks and modest price, contains an amazingly powerful music and sound synthesizer. As you'll recall from last month's column, the heart of this built-in synthesizer is a microprocessor called the 6581 Sound Interface Device—often referred to as SID.

In the Commodore 64, this kid named SID controls a big block of RAM that extends from memory address $D400 through $D418 (54272 to 54296 in decimal notation). This chunk of memory can be broken down into four smaller segments, as follows:

\$D400 -\$D406 :	Registers for Voice 1
\$D407 -\$D40D:	Registers for Voice 2
\$D40E-\$D414 :	Registers for Voice 3
\$D415 -\$D418 :	Filter and Volume Controls

As you can see, the SID chip has three *voice registers*. Each register has a voice of its own, and each voice can be programmed independently of the other two. So SID can use his three voices to produce music in three-part harmony.

In addition, each of SID's three voices can produce many different kinds of sounds, and the characteristics of the sounds generated by each voice can be different from those of the sounds produced by the other two. So SID can be programmed to sound like a band of three different instruments playing simultaneously.

As the table above indicates, the block of memory that extends from $D415 to $D418 contains a set of registers labeled "filter and volume controls." These registers are used to control the volume and some of the sound characteristics of SID's three musical voices.

WAVEFORMS: THE SHAPES OF SOUNDS

SID's filter and volume controls are used to control the *timbre*, or overall characteristics, of SID's sounds. As you may recall from last month's column, the timbre of a sound is determined by a structure called a waveform. And SID, as last month's column also explained, can produce four distinct types of waveforms: a triangle waveform (which can sound like a xylophone or an accordion), a sawtooth waveform (which can resemble the sound of a trumpet or a harpsichord), a pulse waveform (which comes close to sounding like a piano) and a random-voice waveform (which can be made to sound like explosions and the sounds of percussion instruments).

The SID chip uses three registers—one for each voice—to determine the waveforms of sounds. These registers, called control registers, are $D404 (for voice 1), $D40B (for voice 2), and $D412 (for voice 3).

Only the high-order bits (4 through 7) of these control registers are used for determining waveforms. When bit 4 of a control register is set, the voice which that register controls will produce a triangle waveform. If bit 5 is set, a sawtooth waveform will be produced. Setting bit 6 will result in the generation of a pulse waveform, and setting bit 7 will generate random noise.

If none of these bits are set, the waveform that is produced will be a sine wave—a wave that produces a pure sound with no overtones.

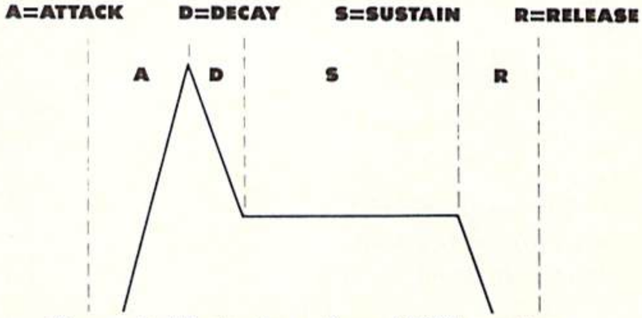


Figure 1: Illustration of an ADSR envelope.

THE ADSR ENVELOPE

One important characteristic of sound is *dynamic range*—the different in volume between the loudest level and the softest level of a sound. In the C-64, dynamic range is determined by something called an Attack/Decay/Sustain/Release (or ADSR) envelope.

The C-64 ADSR envelope derives its name from the fact that every musical note can be broken down into four distinct parts, or phases. These four phases in the life of a note are illustrated in Figure 1.

THE ATTACK AND DECAY CYCLES

The attack phase comes first because every note starts with an attack. The attack phase is the length of time that it takes the note to rise from no volume at all (a level of zero) to the note's maximum volume.

Once a note reaches its peak volume, its decay phase begins. The decay phase is the length of time it takes for the note to decay from its peak volume to a predefined "sustain" volume.

The SID chip uses three memory registers to control the attack and decay phases of notes. These are $D405 (for voice 1), $D40C (for voice 2), and $D413 (for voice 3).

Each of thesse attack/decay registers is divided into two parts: a low nibble (bits 0 through 3) and a high nibble (bits 4 through 7). To set the attack phase of a note, the high nibble of the attack/decay register is used. To set the decay phase of a note, the low nibble of the register is used. Each nibble can be set to a value ranging from $0 (for a duration of 2 milliseconds, or 2/1000 of

a second) to $F (for a duration of 8 seconds).

THE SUSTAIN AND DECAY CYCLES

As soon as the decay cycle of a note ends, its sustain cycle begins. During a note's sustain cycle, the note is held for a certain length of time at a predetermined volume. Then the note's release phase begins. During the release phase, the note drops from its sustain level to no volume at all, or a zero volume level.

Each of SID's three voices has one register that controls both the sustain and the release characteristics of the notes which that voice produces. The SID chip's sustain/release control registers are $D406 (for voice 1), $D40D (for voice 2), and $D414 (for voice 3).

To set the volume of a note's sustain cycle, the low nibble of the note's sustain/còntrol register must be set to a value ranging from $0 (for no volume) to $F (to keep the sustain level at the note's peak volume). The duration of a note's sustain level is not determined by the setting of this nibble; to control the duration of the sustain level, a timing loop or some other kind of timing device must be used.

The release cycle of a note is controlled by the low nibble of the note's sustain/release register. Each release nibble can be set to a value ranging from $0 (for 6 milliseconds) to $F (for 24 seconds).

SETTING SID'S VOLUME

As explained last month, the volume levels of SID's three voices cannot be independently controlled: SID has only one volume-control register, and it always sets all three voices to play at the same volume. To set the overall volume of SID's sound, all you have to do is place a value ranging from $0 through $F in the lower four nibbles (bits 0 through 3) of Memory Register $D418 (often referred to as the SIGVOL register). The larger the value of this nibble, the louder SID's music. In most applications, the volume nibble of the SIGVOL register is kept at $F, its loudest setting.

PLAYING THE MUSIC

Once a note's volume and frequency have been set, and a waveform and an ADSR envelope have been programmed, the music can begin. To start a note, only one more bit must be set: a special bit called a *gate bit*. The SID chip has three gate bits, one for each voice, and each located in a different register. The three registers are $D404 (for voice 1), $D40B (for voice 2), and $D412 (for voice 3). The astute reader may recall that these three registers were mentioned earlier: their high-order nibbles are used to select the patterns of the waveforms that the SID chip generates. Now we can take a look at their low-order nibbles, working backwards from bit 3.

Bit 3 of each of these registers is called a *test bit*; it is used to disable an oscillator that is built into the voice that each register controls. When this oscillator is disabled, complex waveforms can be produced under software control—even waveforms that approximate those of human speech. When the oscillator is enabled, the sound of the associated voice becomes more musical.

Bit 2 of each SID control register is called a *ring modulation bit*. When this bit is set to 1, the triangle waveform of the voice controlled by the register is replaced by a ring-modulated combination of two oscillators. The associated voice may thus be used to simulate the sound of a bell or a gong.

Bit 1, known as a *synchronization bit*, can be used to synchronize the fundamental frequency of one oscillator with the fundamental frequency of another oscillator, thus enabling the programmer to create a wide range of complex harmonic structures using voice 1.

Bit 0 of each SID control register is the *gate bit* that starts a note. When a note's volume, frequency, waveform, and ADSR envelope have been determined, and when the SID chip has been given any other information which it may need to play the note, the gate bit can be set and the note will begin. To stop the note—whether it has completed its ADSR cycle or not—all a programmer has to do is clear the gate bit. The note will then stop playing. Once the gate bit has been cleared, the settings of any SID registers can be changed as desired. Then another note can be played—or another sound created—by setting the gate bit again.

To play the same note or create the same sound over and over again, all a program has to do is set and clear the gate bit repeatedly, while all other SID settings remain the same.

USING INTERRUPTS

The type-and-run program called MUSIC.S (see page 86) is a fairly simple assembly language program that can turn your Commodore's keyboard into a piano keyboard. Before you type and run the program, though, it might be helpful to understand the concept of *interrupts,* which are used in most high-performance music and graphics programs.

An interrupt–often referred to by its assembly language mnemonic, IRQ–is a high-priority routine designed to interrupt lower-priority programs, if necessary, so that it can do its work properly. No matter what is happening when an interrupt is called, a computer will stop everything else it is doing in order to process an interrupt (unless an even higher-priority interrupt is in progress, in which case the higher-level interrupt will be allowed to finish what *it* is doing before the lower-level interrupt begins). In other words, in an assembly language program, an interrupt always goes to the head of the line, where it can keep other routines waiting until it has done what it is supposed to do.

Assembly language programmers often use interrupts when they want to write time-critical routines. One very important interrupt routine is built into the Commodore 64's operating system. Called a hardware interrupt routine, it takes place exactly 60 times each second, during a brief period when the C-64 is not displaying anything at all on its screen. During this period, known as a screen refresh cycle, many essential housekeeping operations take place, all controlled by interrupts. The C-64's internal clock is updated, the keyboard is read, and a cursor-blinking operation is performed. When these and other essential chores are finished, the computer's hardware interrupt routine ends, and normal processing can resume.

The C-64's hardware interrupt routine can be of great assistance to the assembly language programmer. That's because it can be customized with the help of something called a *hardware interrupt vector.* In assembly language jargon, a vector is an entry point in an assembly language program. Usually, a vector is nothing but a pointer to the next routine in a program. But it is a special kind of pointer because it can be "stolen," or made to point to another subroutine. When a vector is stolen, the routine that it is made to point to is usually one that has been written by the person stealing the vector. When such a user-written routine ends, it usually terminates with an unconditional jump to the same routine that the stolen vector originally pointed to.

The effect of "stealing" a vector, then, is simply to insert a user-written routine into a set of operations that would ordinarily be controlled exclusively by a computer's operating system. If the stolen vector is part of the computer's screen-refresh cycle, the user-written routine will take place 60 times a second, with quartz-clockwork precision, and without any further effort on the part of the assembly language programmer!

A vector-stealing operation can be very easily used to customize the hardware interrupt routine used by the C-64. The vector that is usually stolen as part of this operation is called, logically enough, the hardware interrupt vector. It resides at memory addresses $0314 and $0315, and it is often labeled the CINV vector in C-64 programs.

A POTENTIAL PROBLEM

There is one more possible snag that must always be accounted for if the CINV vector is to be stolen successfully. Here it is:

The CINV vector consists of two 8-bit memory registers which, in combination, always hold a 16-bit address. So it takes two operations to alter the CINV vector. First the low byte that it points to must be changed. Then the high bit that it points to must be altered.

Since the CINV vector must be changed in two stages, there is always a chance that the C-64's hardware interrupt may begin after one of the vector's bytes has been changed, but before the other byte has been altered. If this happens, the CINV vector may point to a meaningless address when it is called, resulting in a program crash

or a system failure.

To prevent this kind of catastrophe from taking place, the C-64's 6502 chip has two special instructions for making sure that interrupts are dealt with safely. One of these instructions is SEI, which stands for "set interrupt disable." The other is CLI, for "clear interrupt disable." When an SEI instruction is used in an assembly language program, the interrupt disable flag of the 6502 processor status register is set, and no maskable interrupts can take place. (There are two kinds of interrupts: maskable and nonmaskable. The CINV interrupt is of the maskable variety.)

When a CLI instruction is invoked during an assembly language program, it has just the opposite effect from that of the SEI register: it clears the P register's interrupt disable flag, and maskable interrupts are enabled.

The SEI and CLI instructions are tailor-made for applications like stealing the C-64's CINV vector. To make sure that a program does not crash when the CINV vector is stolen, simply use the instruction SEI before you change the vector, then use the CLI instruction after you've changed it. Then no interrupts will take place while the CINV vector is being altered, and the vector can be safely changed.

In MUSIC.S, the CINV vector is altered to include a note-timing loop. That ensures that the notes produced by the program will always be precisely timed.

In Lines 56 through 59 of MUSIC.S, the CINV vector is stored in a pair of memory addresses called USERADD and USERADD+1. Next, in Line 60, the SEI instruction is used to disable maskable interrupts. When that has been done, the address of a user-written routine (a note-timing loop) is stored in the address of the CINV vector. Then interrupts are reenabled with a CLI instruction.

The note-timing routine added to the CINV vector is labeled WAIT. It can be found in Lines 112 through 119 of MUSIC.S. The note-time routine ends with the statement

```
JMP (USERADD)
```

That statement ends the user-written note-timing loop with a jump to the address originally pointed to by the CINV vector.

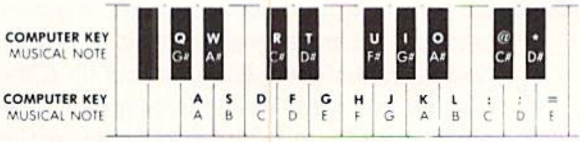


Figure 2: Keyboard arrangement for the MUSIC.S program.

RUNNING THE MUSIC.S PROGRAM

The MUSIC.S program was written using the *Merlin 64* assembler, but with relatively minor modifications it can be adapted for use with any assembler that is compatible with the C-64. When the program has been typed and assembled, it will convert your 64's keyboard into a piano-style keyboard. When the program is running, the middle row of keys–the row that starts with "A"–can be used like the white keys on a piano. The keys on the top row of your keyboard–beginning with "Q"– can be used as black keys. Figure 2 illustrates this arrangement.

Once you know how SID produces sounds, the MUSIC.S program is fairly easy to follow. And once you have it up and running, I'm sure you'll be able to find many ways that it can be improved. As written, the program makes use of only one of SID's voice registers, but there is no reason that it couldn't make use of all three, enabling you to pound your keyboard in three-part harmony.

The MUSIC.S program could be improved even more with some eye-catching color graphics. You could use either character graphics or high-resolution graphics to print a piano keyboard on your screen, and then print a note or some other symbol on any key that is hit to indicate that it's the key being played. And why not turn the "piano" used in the program into an electric organ or a music synthesizer, complete with "stops" designed to approximate the sounds of other instruments? With a little imagination, along with what you've learned about assembly language from reading these columns, I'm sure you can customize the MUSIC.S program in any of these ways, and many others! □

SEE PROGRAM LISTING ON PAGE 86



COMMODARES

PROGRAMMING CHALLENGES

By Dale Rupert

Each month, we'll present several challenges designed to stimulate your synapses and toggle the bits in your cerebral random access memory. We invite you to send your solutions to:

Commodares, c/o *Ahoy!*
P.O. Box 723
Bethel, CT 06801

We will print and discuss the cleverest, simplest, shortest, most interesting and/or most unusual solutions. Be sure to identify the *name* and *number* of the problems you are solving. Also show sample runs if possible, where appropriate. Be sure to tell what makes your solutions unique or interesting, if they are.

Programs on diskette are welcome, but they must be accompanied by listings. You must enclose a stamped, self-addressed envelope if you want any of your materials returned. Solutions received by the middle of the month shown on the magazine cover are most likely to be discussed, but you may send solutions and comments any time. Your original programming problems, suggestions, and ideas are equally welcome. The best ones will become *Commodares*!

PROBLEM #30-1: FUNCTIONAL ENTRY

This problem is based upon a suggestion from Glen Bohusch (Erie, PA). Add the necessary lines to the following program to allow the user to type the definition for the function FNA(X). Once the definition has been entered, the program prints the values of the function in line 100.

```
10 PRINT "DEFINE THE FUNCTION FNA(X) = "
.....
100 FOR X=1 TO 10 : PRINT FNA(X) : NEXT
: END
```

PROBLEM #30-2: WHAT ENVIRONMENT?

Write a simple routine that determines the type of computer (VIC 20, C-64, C-128, or others), the current screen colors, and whether the screen is in 80, 40, or 20 column mode. This routine could be executed at the start of a program and would allow the program to behave differently for the different types of computers.

PROBLEM #30-3: WORD WRAPPER

Jim Speers (Niles, MI) has suggested yet another outstanding challenge. Very simply, see if you can implement the word-wrap function found on most word processors. Your program should allow text to be typed and displayed with a cursor. When a word is typed which will not all fit at the end of a line, it is to be erased, and as much of the word as has been typed is moved down to the start of the following line where typing continues.

Your solution should allow <DEL> and <RETURN> to operate properly. Cursor keys, <INS>, and <HOME> may be ignored. Jim used the back-arrow key to erase his graphic cursor and to end the program.

PROBLEM #30-4: COLOR BARS

Here is one for which the solution should be many times shorter than the description of the problem. This program prints randomly colored graphic blocks horizontally across the screen starting at the top row. Once two consecutive blocks of the same color have been printed, blocks are printed in pairs. Each pair will have randomly selected colors, but the two blocks in the pair are the same color. This continues until three consecutive pairs all have the same color, at which time blocks are printed three at a time with each of the triplets having the same color. And so forth.

An example should clarify the task:

```
CACBEDDBBEECCCCCCBBBAAADDDBBB...
```

Each letter represents a character-size graphics block, and different letters correspond to different colors. Initially every block is a different color until two consecutive blocks of color D are printed. Then blocks are printed in pairs until three pairs with the same color C are printed. Now triples are printed until four consecutive triples have the same color, at which time the colored blocks are printed four at a time. The process continues *ad infinitum.*

Allow scrolling after the bottom row is printed. What is the likelihood that the screen will ever be entirely one color?

Before we get to the solutions to *Commodares* from the February 1986 issue of *Ahoy!*, let's look at another contender for the World's Longest Listable Line championships. The clearcut winner (although achieved by devious means) is the following submission from Ben Mit-

chell, Jr. (New York, NY):

```
1 POKE 774,45
```

Run this one-liner, then try to list it. The line number is displayed followed by an infinite number (count 'em) of CMD commands! Of course I'm taking Ben's word that there are infinitely many of them—at least my computer didn't show any sign of reaching the end of the line.

This POKE statement tampers with a LIST command vector. Even the RUN/STOP-RESTORE sequence does not return things to normal. I suggest you find out what is normally stored in location 774 by typing PRINT PEEK(774) *before* you run the program. When you are tired of counting CMD's, restore the LIST vector to its original value by typing POKE 774,XXX where XXX is the value displayed by the PRINT statement.

The same procedure works for the C-128, but instead of showing infinitely many CMD's, the LIST command will generate an audiovisual show.

Len Lindsay (Madison, WI) raised an important question in his latest COMAL solutions to *Commodares.* He asked why we are always so concerned with the *shortest* or *most compact* programs rather than the *most readable* or *easiest to follow.*

Len's well-taken implication is that there is more to programming than cramming the most statements onto a single line. In fact the dictates of good programming generally frown upon such antics. On the other hand, the spirit of *Commodares* is intellectual pastime and good clean fun. There is no reason that every program we write must be easily interpretable, documentable, or even debuggable.

There is at least as much intellectual challenge in paring and rearranging a program's logic to allow it to fit onto one line of code as there is in writing the program in a rigorously structured and documented format. As far as changing the emphasis of this column from "shortest" to "most readable," we generally look for a happy medium. The length of the program is usually determined by its number of statements rather than its number of program lines. Sometimes (although certainly not always) one statement per line is preferred. All other factors being equal, the most readable, compact solutions are most likely to be used in this column.

We are certainly not biased against COMAL (to assuage Len's concern) or any other language. Structured programming is generally a desirable goal, and COMAL (along with Pascal and Modula-2 among others) certainly encourages structured programming. But in this column we are playing games and solving puzzles, and a compact five-line program can be a more appropriate solution than a structured twenty-line program. Most important, keep those solutions coming in whatever language you prefer to write.

Problem #26-1: Apples Anyone?, submitted by Ted Grondski (Springfield, MA), brought essentially two classes of solutions, the random search and the sequential search. Representative of the random search approach is the following program from Jacqueline Callaway (Orange Beach, AL):

```
1 REM
2 REM COMMODARE #26-1 :
3 REM      APPLES ANYONE?
4 REM SOLUTION BY
5 REM JACQUELINE CALLAWAY
6 REM
10 FOR I=1 TO 4 : READ L$(I) : NEXT
20 A=1 : B=2 : K=3 : D=4
30 W=INT(RND(1)*4)+1 : X=INT(RND(1)*4)+1
 : Y=INT(RND(1)*4)+1 : Z=INT(RND(1)*4)+1
40 IF A*W+B*X+K*Y+D*Z+A+B+K+D<>32 THEN30
50 IF W<>X AND W<>Y AND W<>Z AND X<>Y
 AND X<>Z AND Y<>Z THEN 70
60 GOTO 30
70 PRINT"ANN ";L$(W) :PRINT"BETH ";L$(X)
 :PRINT"KATE ";L$(Y) :PRINT"DOT ";L$(Z)
80 DATA SMITH, BROWN, BLACK, ROBINSON
```

Ann, Beth, Kate, and Dot got one, two, three, and four apples respectively. Ed Smith took as many as his sister. Fred Brown, George Black, and Jack Robinson each took two times, three times, and four times respectively as many apples as his sister. Since the total number of apples is 32, the statement in line 40 determines if the values of W, X, Y, and Z meet the specifications.

Rather than stepping through each possible combination of W through Z, Jacqueline's program randomly picks values for the four variables and tests them. The other conditional tests on line 50 make sure that no two variables have the same value.

The sequential search method is shown in this solution from Michael Marron (Stony Brook, NY):

```
1 REM
2 REM COMMODARE #26-1 :
3 REM      APPLES ANYONE?
4 REM SOLUTION BY
5 REM MICHAEL MARRON
6 REM
10 FOR I=1 TO 4:READ F$(I):NEXT I
20 DATA ANN, BETH, KATE, DOT
30 FOR A=1 TO 4 : FOR B=1 TO 4 : FOR C=1
 TO 4 : FOR D=1 TO 4
40 IF A=B OR A=C OR A=D OR B=C OR B=D OR
 C=D THEN 60
50 IF A+2*B+3*C+4*D+10=32 THEN GOSUB 70
60 NEXT D:NEXT C:NEXT B:NEXT A: END
70 PRINT F$(A);" SMITH",F$(B);" BROWN",F
$(C);" BLACK",F$(D);" ROBINSON":RETURN
```

Nested FOR-NEXT loops guarantee that every possible permutation of values will be tested.

For this problem with a small, finite number of possible combinations (namely 24), either solution is satis-

factory. The random method is desirable when there might be infinitely many combinations to test and not all solutions are required. The sequential method allows you to gauge the amount of time needed to find all solutions, even though it may or may not find those solutions more quickly than the random method. There is no way to know when the random method will hit upon the final solution. By the way, how would you solve this problem without a computer–randomly, sequentially, or with some combination of the two methods?

The solution from John Prager (Bay City, MI) to his own *Problem #26-2: What's Your Sine* nicely handles some of the intricacies of this problem. Without using log or trig functions, John's program calculates the sine of an angle given in radians.

```
1 REM
2 REM COMMODARE #26-2 :
3 REM   WHAT'S YOUR SINE?
4 REM SOLUTION BY
5 REM JOHN PRAGER
6 REM
10 INPUT "ANGLE (RADIANS)";X:S=X:F=X:N=1
20 F=-F*X/(N+1)*X/(N+2):N=N+2:S=S+F:IF F
<>0 THEN 20
30 PRINT"SINE :"S
```

Most solutions used the Taylor (Maclaurin) series expansion of the sine function:

$$\sin X = X - X^3/3! + X^5/5! - X^7/7! \ldots$$

where 7! (read 7 factorial) means 7*6*5*4*3*2*1 or 5040 for example. Each term is reached by multiplying the preceding term by X squared and dividing by the negative of the product of the next two integers, hence

$$X^5/5! = - X^3/3! * X * X / (4 * 5)$$

In John's program, S stores the sum of the terms and F stores each individual term. By alternating the multiplications and divisions, John's program is less likely to overflow (at least for values of X greater than one). John's program is also self-terminating. Once a term has been reached which is small enough to be stored as zero in the computer, line 30 is executed and the result is printed. You might add a PRINT N statement at the end to see how many terms are evaluated for various values of X.

This series expansion is not very accurate for large values of X. It is good to about five decimal places for X equal to 10. You could take advantage of the fact that

$$\sin (X + N * \pi) = \sin (X)$$

for every even integer N to modify large values of X. Simply reduce the magnitude of the input number X by removing multiples of 2 * pi before starting at line 20. These statements will work:

```
5 PI = 3.14159265
15 IF ABS(X) > PI THEN X = X - SGN(X) *
2 * PI : S=X : F=X : GOTO 15
```

The SGN function allows negative values of X to be increased and positive values to be decreased.

The award for the shortest solution to this problem goes to Jack Silver (Medford, NY). One of Jack's solutions is simply

```
1 INPUT X : PRINT X
```

Indeed for angles very close to zero radians, the sine of the angle is very close to the angle itself. (See that for yourself in the series expansion above. If X is less than one, then X cubed is much less than one, and the first term is the most significant term.)

You might enjoy investigating the accuracy of Jack's program for various values of X. Compare SIN(X) with X as X approaches zero.

Edward Majewski (Milwaukee, WI) used a different method to find the sine of X. He evaluated the first five terms of a Chebyshev series polynomial.

```
1 REM
2 REM COMMODARE #26-2 :
```

```
3 REM   WHAT'S YOUR SINE?
4 REM SOLUTION BY
5 REM EDWARD MAJEWSKI
6 REM
10 B1=1.5707963:B3=-.64596336:B5=.079688
475:B7=-.0046722203:B9=.00015081716
20 INPUT"ENTER VALUE IN RADIANS";X : X=X
*2/+
30 Y=B1*X+B3*X^3+B5*X^5+B7*X^7+B9*X^9
40 PRINT"CALCULATED SINE";Y
50 PRINT"COMPUTER VALUE ";SIN((+/2)*X)
```

Edward's program is very accurate for X between −PI/2 and PI/2. To eliminate the exponentiation and in some cases improve accuracy, line 30 may be rewritten as follows:

```
30 X2 = X*X : Y = X * (B1 + X2 * (B3 + X
2 * (B5 + X2 * (B7 + X2 * B9))))
```

This type of polynomial expansion with stored constants is often the way that computers and calculators evaluate the advanced functions. Books on numerical analysis will provide further information on this subject.

No one sent all 66,150 possible four-letter "words" containing two vowels each (fortunately). However, there were several programs submitted which do generate such a list for *Problem #26-3: Dual Vowels.* For this problem some programs "built" the four-letter words to have exactly two vowels while others generated every possible combination of four letters and printed only those which contained just two vowels.

The following program from Paul Mather (Warminster, ONT) is the shortest and most straightforward of the solutions received.

```
1 REM
2 REM COMMODARE #26-3 :
3 REM   DUAL VOWELS
4 REM SOLUTION BY
5 REM   PAUL MATHER
6 REM
10 A$(1)="AEIOU":A$(2)="BCDFGHJKLMNPQRST
VWXYZ"
20 FOR Z=1 TO 6
30 READ X1,X2,X3,X4
40 FOR C1=1 TO LEN(A$(X1))
50 FOR C2=1 TO LEN(A$(X2))
60 FOR C3=1 TO LEN(A$(X3))
70 FOR C4=1 TO LEN(A$(X4))
80 PRINTMID$(A$(X1),C1,1);MID$(A$(X2),C2
,1);MID$(A$(X3),C3,1);MID$(A$(X4),C4,1),
90 NEXT C4,C3,C2,C1
100 NEXT Z
110 DATA 1,1,2,2, 1,2,1,2, 1,2,2,1, 2,1,
1,2, 2,1,2,1, 2,2,1,1
```

There are six different orientations for the two vowels within the four-letter word: positions 1&2, 1&3, 1&4, 2&3, 2&4, and 3&4. The DATA values in line 110 are read four at a time. A value of 1 corresponds to A$(1) which stores the vowels, and a value of 2 corresponds to A$(2) which stores the consonants. Each possible letter from the vowel array or the consonant array is chosen and used in the appropriate position in line 80.

It is easy to see how the total number of words may be calculated by looking at Paul's program. The Z loop is executed six times. Within each Z loop, the first vowel will have five different values as will the second vowel. Similarly the first and second consonants will each have twenty-one different values. The result is (6 * 5 * 5 * 21 * 21) or 66150 total combinations.

Martin Brookes (Framingham, MA) mentioned that his program took 2 hours 39 minutes to find the 66150 words. You might see if your program can beat his average of almost seven words per second.

During his work on *Problem #26-4: Spelled Number,* Wallace Leeker (Lemay, MO) uncovered a rather interesting and very subtle bug in his C-64. He discovered that Rob Lackey's program printed in the September 1985 *Commodares* did not give the correct result for the numbers 700 and 900. Rob's program inputs a number less than 10,000 and spells out the English equivalent. Strangely enough, 900 comes out "eight hundred" and 700 becomes "six hundred."

Even more puzzling was the fact that on an IBM PCjr, Rob's program works fine. So Wallace assumed there must be something wrong with his C-64. Alas, it looks as though the problem with the C-64 is somewhere in the firmware (BASIC software in ROM). On the C-128, Rob's program works fine. On the C-128 in C-64 mode, 900 still comes out "eight hundred."

Here's a short program which displays the problem.

```
1 REM
2 REM --- C-64 BUG ---
3 REM
10 FOR N=0 TO 9999
20 A=N/1000-INT(N/1000)
30 B=10*A:C=INT(B)
40 D=INT(10*(N/1000-INT(N/1000)))
50 IF D<>C THEN PRINT N,C,D
60 NEXT
```

In this program, D should equal the number of "hundreds" in N. A, B, and C are equivalent to the parts that make up D, and C should have the same value as D. On the C-128, this program does not print any values, meaning that C is equal to D for all numbers tested. On the C-64, however, three values of N from 0 to 9999 give different results for C and D (700, 900, and 1900).

The culprit, as many of you have no doubt surmised, is probably related to the internal storage and round-off of values. It is surprising that the C-64 and the C-128 handle the situation differently. Maybe there's more to the problem than internal round-off. Let us know what you uncover.

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Back to the problem at hand, the answer to *Problem #26-4* is that there is no answer. No number is equal to the sum of the letter values in its name (A=1, B=2, and so forth; "ONE" equals 15 + 14+ 5 or 34). Actually, David Stidolph (Madison, WI) sent a COMAL program which interprets the number "146" as "ONE FOUR SIX" (instead of "ONE HUNDRED FORTY SIX") and thereby found that this number does equal its letter value.

The solution from Michael Marron (Stony Brook, NY) is printed below. His program lists every number which differs from its "name values." The name values for each number are stored in the array V( ). The numbers 219 and 253 differ from their name values by only one.

```
1 REM
2 REM COMMODARE #26-4 :
3 REM   SPELLED NUMBER
4 REM SOLUTION BY
5 REM   MICHAEL MARRON
6 REM
10 PRINT" #","VALUE","DIFFERENCE"
20 DIM V(30):V(0)=0:X=-1
30 FOR I=1 TO 29:READ N$:S=0
40 FOR J=1 TO LEN(N$):V=ASC(MID$(N$,J,1)
)-64:S=S+V
50 NEXT J: V(I)=S :NEXT I
60 FOR A=0 TO 9 : FOR B=0 TO 9
70 IF A=0 THEN T=0
80 IF B=0 THEN H=0
90 FOR C=0 TO 19:X=X+1:GOSUB 150:NEXT C:
C=0
100 FOR D=20 TO 27:FOR E=0 TO 9
110 X=X+1:GOSUB 150:NEXT E:NEXT D
120 D=0:E=0:H=V(28):NEXT B:T=V(29):NEXT
A
130 END
150 V=V(A)+T+V(B)+H+V(C)+V(D)+V(E)
160 IF X<>0 AND ABS(X-V)<=5 THEN PRINT X
,V,ABS(X-V)
180 RETURN
900 DATA ONE,TWO,THREE,FOUR,FIVE,SIX,SEV
EN,EIGHT,NINE,TEN,ELEVEN,TWELVE
910 DATA THIRTEEN,FOURTEEN,FIFTEEN,SIXTE
EN,SEVENTEEN,EIGHTEEN,NINETEEN
920 DATA TWENTY,THIRTY,FORTY,FIFTY,SIXTY
,SEVENTY,EIGHTY,NINETY,HUNDRED,THOUSAND
```

Thanks to Jim Speers (Niles, MI), Len Lindsay (Madison, WI), Martin Brookes (Framingham, MA), and Wallace Leeker (Lemay, MO) for their solutions to this and other problems.

Other readers with contributions to *Commodares* this month include David Stein (Arlington, VA), Bill Binder (Northville, MI), James Hendrix (White Sands Missile Range, NM), Carolyn Predmore (Lawrence, KS)—hello to the University of Kansas, Bill Okerblom (Providence, RI), Louis Lemire, Frank Smith (Schaumburg, IL), Scott Nicodemus, John Fraleigh (Wappingers, NY).

Also congratulations to M. Mak (NY, NY), David Hoffner (Brooklyn, NY), Steve Pietrowicz (APO NY–Bad Toelz, Germany), Bob Muhlstadt (Henry, IL), Harold Garter (Phoenix, AZ), Martin McCallister (Scio, OH), Pete Troy (Casco, ME), Robert Post (Ft. Riley, KS), Robert Schader (Wyoming, MI), Michael van Bodegom (St. Albert, ALB), Charles Grady (Cleveland, TN), Ben Pflanzer (Lake Villa, IL), Eddie Byrd (White Oak, MO), Tom Isaman (San Antonio, TX), Thomson Fung (San Diego, CA), Karen Middaugh (San Diego, CA), Robert Johnson (Chico, CA), Dennis Diskin (Bozrah, CT), Billy Brown (Ruston, LA), and James Borden (Carlisle, PA).

Here's one more strange occurrence (whether it is a bug or not, we will leave up to you). Type this in direct mode and look at the results:

```
PRINT MID$(CHR$(34),1);2;3
```

How do you explain those CHR$(29) (reverse right brackets) following the 2 and the 3 in the computer's response? Something to do with that crazy Insert-Quote mode? Let us know what you figure out.

With two bugs to track down and some serious challenges this month, you should have some busy but enjoyable programming ahead. Keep those solutions and problems coming! ☐

THRUSTING INTO THE PUBLIC DOMAIN

Free Programs are a Modem or Mailing Fee Away!

BY CHERYL PETERSON

Within a short time of buying a computer, most owners learn that buying software could send them to the poorhouse if they aren't selective. The great number of packages that purport to serve the same function can make choosing software a nightmare. (We'll pretend that we don't know about those unscrupulous people who steal software.) Inexpensive software (marketed by companies like Mastertronic) does exist, but it certainly doesn't abound. With prices ranging from $15 to as high as $150 or more, it can be terribly difficult to accumulate a good mixture of useful packages.

And typically, when you find a commercial package that is almost what you need, you find that you can't modify it to make it work the way you want. The manufacturer won't help you and prevents you (through compiling and/or copy protecting his program) to let you make the changes yourself.

Outside of magazines, where does one find inexpensive packages that perform useful functions? And how can you modify these to do what you want? How is the honest computerist to find affordable software that keeps the kids entertained or helps them learn?

One good source of "almost free" programs is public domain (PD) software. Such programs usually cost little more than a disk copying and shipping fee. This software is distributed by a number of different organizations and is not copy-protected or copyrighted.

Copyright law provides a way for the author of a program, song, or literary or art work to prohibit others from distributing his creation. The author can selectively sell others the right to copy and distribute this work.

A public domain work, on the other hand, is one that is not covered by copyright. Currently works can only be copyrighted for the life of the author plus 50 years, or until the author relinquishes all rights. Relinquishing copyright can be as easy as failing to put the proper copyright notice on. However, if you get a copy of a program that has had the notice removed, it is still protected! So watch out for illegal copies. Sometimes it's hard to tell the difference between PD software and stolen software, but the copyright is valid if the owner places notices on all the copies he sells.

Many groups sell PD software for reasonable copying fees. These groups may have improved an old version of a program and put a copyright notice on it. If there is a copyright notice, you don't have the right to give it to friends.

The major communications services all offer PD software for downloading somewhere on their networks. CompuServe, PlayNET, and QuantumLink all have libraries of C-64 software. All you pay are connect charges while you are downloading. Each has a special procedure to capture the software on disk.

If there are electronic bulletin board systems (BBS's) in your area, they may have PD programs available to download. Some boards charge users a small sign-on fee to join. This one-time fee to join assures that members remember their passwords.

Another good source is Commodore user groups. Most local groups have a library of software that members are allowed to copy. In some cases, members buy programs for a small charge that covers disks and a copying fee. User groups usually have a membership fee that defrays the costs of running the group.

National groups, such as TPUG (the Toronto Pet User Group), also distribute public domain software to their members. See the list included with this column for addresses.

Many types of programs are available – games for children and adults, educational programs, productivity programs, and utilities that simplify many chores. BASIC, CP/M, and Amiga programs are being distributed.

The complexity of these programs rarely challenges that of commercial software. While some commercially offered software is little more than PD programs modified and documented, this shouldn't deter interest in PD packages. You may not know it, but the *Zork* series of programs was developed from a program called "ADVENTUR" that is still available on most electronic BBS systems. Obviously, the *Zork* programs are more complex, but they are also more expensive.

And sometimes a PD program's simplicity is an advantage. For instance, one program that I use frequently is *VDO.* This text editor was originally written as a quick and dirty (yet flexible) way to edit programs in CP/M. It wasn't meant to perform all the fancy gyrations that can be accomplished with a commercial package. *ED,* the text editor generally provided with CP/M, is a pitifully minimal editor and *VDO* was conceived as a way to avoid using *ED.*

VDO's big advantage is its size. At only 4K, it could be put on every disk. The utility of this becomes obvious when you are using a one disk drive system and want to do cleanup on your disks. Can you remember what's

in all those text files? Can you imagine putting a full-blown word processor on every disk you own?

C-128 BEGINNERS

I was pleasantly surprised a few weeks ago to receive a call from a local travel writer who was planning to computerize her writing. A local writers' group had recommended she contact me first. Her decision to buy a Commodore 128 was surprising to me in light of her total lack of experience with computers. I had (wrongly it seems) assumed that most C-128 buyers were C-64 owners upgrading their systems. As this incident brought home to me, some C-128 owners are also beginners. So I've added C-128 coverage to this column. I hope you approve.

The 1571 isn't as slow as the 1541, provided it is being used with the C-128 mode. Going to C-64 mode slows the 1571 to 1541 speed. But Access Software, designer of the *Mach 5* cartridge, has come up with *Mach 128*. *Mach 128* will speed up loading times from both 1541 and 1571 drives operating in C-64 mode. *Mach 128*'s switches can be set to power up the computer in C-64 or C-128 mode automatically. A cartridge-mounted reset switch can perform a warm reset for you, so you needn't power down if you get locked up.

The *Mach 128* cartridge has the same features as *Mach 5* with special 128 additions. It does work with a C-64 as well. At a $49.95 suggested list price, it's one of the first things C-128 owners will want to look into. Access is still providing its disk organizer program and BASIC +4K with their *Mach* products.

Other products that I've previously mentioned have been upgraded for the C-128. Abacus Software has developed a C-128 version of its BASIC compiler. William Sanders has issued an update to his book *Assembly Language for Kids* to include a C-128 version of the *Kids' Assembler* and information on differences between the C-128 and C-64.

Other good books for C-128 owners are being offered by Microcomscribe. *The Elementary Commodore 128,* also written by William Sanders, is a good place to start learning BASIC 7.0. As with all his books, there are sample programs and plenty of reference tables in the appendix. A more advanced volume, *The Commodore 128 Mode: An Inside View,* goes much deeper into programming and would be more suitable for experienced programmers.

Abacus Software has C-128 books available, but these are also intended for the more experienced. *C-128 Tricks and Tips* and *C-128 Internals* both deal with program-

SOURCES OF PD SOFTWARE

Commodore Software Association
P.O. Box 83655
Los Angeles, CA 90083
$15/year membership fee; $3 per program.

Home Software Systems
P.O. Box 85
Sterling Hts., MI 48077
$16.95 per disk; 5 disks available.

TPUG Inc.
101 Duncan Mill Road, Suite G7
Don Mills, Ontario, Canada M3B 1Z3
$25 membership.

Public Domain Users Group
P.O. Box 1442-CO
Orange Park, FL 32067

Spatial Concepts
P.O. Box 5662
Orlando, FL 32855
$4 for catalog.

John Richards
1040 Haven St.
Mt. Morris, MI 48458
$1 for catalog.

MKMC
Box 506
Newton, KS 67114
$2 for catalog; $3 per disk.

NGCCUG
P.O. Box 250
Clio, MI 48420
$1 for catalog; $6 per disk ($9 double-sided).

COMSIG Club
5838 Freemans Farm
San Antonio, TX 78233
SASE for info; $5 for details disk.

VAS
P.O. Box 4632
Huntsville, AL 35815
Double sided disk, 50 programs $7.50; SASE for catalog.

Schneider Software
440 West Green
West Hazelton, PA 18201
$4.95 per disk or 29 disks, 500+ programs for $39.95.

M&M Software
P.O. Box 3111
Terre Haute, IN 47803
Write for free list.

Knockout Software
P.O. Box 360-A
Pomona, NY 10970
Free catalog.

Futuresystems
Box 3040
Vista, CA 92083
$3 per volume; catalog for large SASE (specify computer).

CP/M

Poseidon Electronics
103 Waverly Place
New York, NY 10011
Catalog for SASE and $1.

AMIGA

Kinetic Designs Amigaware
1187 Dunbar Ct.
Orange Park, FL 32073
SASE for catalog; $9.95 per disk.

ming techniques for the C-128. For those with BASIC programming experience who like to use PEEKs and POKEs, these two books offer a wealth of information.

The CP/M system distributed with the C-128 contains a major deficiency. There is no way to address the user port, so a modem or the Commodore RS232 adapter won't work. Commodore has fixed this problem and is currently claiming that they will send the upgraded operating system to all C-128 owners who mailed their CP/M-Digital Research registration cards. The card, distributed with the operating manual, is *not* the $19.95 special offer card that many users sent in. If you want the upgrade be sure you have mailed the right card.

CompuServe and QuantumLink are all offering the new operating system in their download areas. You must download the *NEWSYS* file to a C-64 format disk and then use a translation program (also available through download) to put the program on a C-128 CP/M disk. When the *NEWSYS* program is run, it modifies the CP/M system file on the CP/M disk. This means that you must have the old system file, *CPM+.SYS,* on the disk.

Once this is done, programs should be able to access the user port. The networks are also offering two modem programs, *IMP* and *XMODEM.* So it is worth it to get the new system if you want to download CP/M software. If you have an RS232 serial printer and want to hitch it to the user port the new system is a must.

Poseidon Electronics (see list) also has the new system and modem programs available on their CP/M software library disks. ☐



"Looks like little Joey has invented another game on his computer!"

TRACKDOWN

For the C-64 and VIC 20

By Buck Childress

If you're tired of sifting through endless program lines, looking for that long lost whatchamacallit, you'll love *Trackdown. Trackdown* is a short machine language program that instantly displays all of the line numbers for anything you seek, whether it's a single letter variable or a whole program line.

On the 64, *Trackdown* resides in an area of memory totally separate from BASIC, so you can load, save, and work on programs without disturbing it.

There's also a version for an unexpanded VIC 20. Since *Trackdown* uses only the top 180 bytes of VIC RAM, you still have over 3400 free bytes. As with the 64, you can load, save, and work on programs without disturbing *Trackdown*. All necessary POKEs needed to protect *Trackdown* from being overwritten by VIC BASIC programs are contained in the loader.

After running *Trackdown* (to get the ML data loaded), load the program you want to work on. Begin by entering whatever you want to find, in the form of a program line, as shown in this example:

```
0 GET#5,A$
```

Because *Trackdown* uses this line for comparison, the line number must be the lowest in the program. I prefer zero because it's the lowest possible line number and very few programs begin with it. If yours does, change it until you're through using *Trackdown*.

Let's say you want to find the sequence FORJ=1TO 1000. Just enter

```
0 FORJ=1TO1000
```

and press RETURN. Type SYS 53000 for the 64, or SYS 7500 for the VIC, then press RETURN. The numbers of all the lines that contain FORJ=1TO1000 will begin to appear on your screen. If you see the same line number more than one time, then it's entered on that line more than once.

Trackdown does count spaces. If you used spaces in the program, enter line zero with spaces:

```
0 FOR J = 1 TO 1000
```

You can shorten it to

```
0 FOR
```

and get the same line numbers plus the line numbers of all the other FOR-NEXT loops in your program.

Finding a variable, such as A=1, is done by entering:

```
0 A=1
```

Press RETURN, make the proper SYS, and there's the locations of A=1. Shortening it to

```
0 A=
```

returns the locations of the variable A, no matter what its value.

Trackdown really saves time when you want to find numbers, especially in long data lists. To find a certain number, say 169, enter

```
0 #169
```

Make sure to use the number sign. *Trackdown* will return all the numbers of the lines containing 169.

If you're looking for commands (keywords), don't shorten them. For example, if you want to find where PRINT appears, don't shorten it to:

```
0 PRI
```

The computer translates PRINT, POKE, GET, and other keywords into tokens.

When looking for a keyword that's contained within quotes (e.g.: I'll GET the car), put quotes in front of it:

```
0 "GET
```

In this case the word "GET" will be tracked instead of the GET command. The quotes at the beginning will prevent the keyword from being tokenized (in this case GET). *Do not* put quotes at the end. *Trackdown* doesn't like end quotes (kind of like spinach, I guess).

Remember, you can find anything, from a single character to a whole program line. Experiment with *Trackdown*. It's easy to use and really saves time. ☐

SEE PROGRAM LISTING ON PAGE 105

COMPANIES MENTIONED IN *SCUTTLEBUTT*

For additional information on any of the products mentioned in this issue's *Scuttlebutt* section (see page 8), we recommend that you write or call the companies listed below directly.

Activision
2350 Bayshore Frontage Road
Mountain View, CA 94043
Phone: 415-960-0410

Addison-Wesley Publishing Co.
Reading, MA 01867
Phone: 617-944-3700

Bouncing Dog Software
P.O. Box 6753
Minneapolis, MN 55406
Phone: 612-729-7662

Brown-Wagh Publishing
1242 South Highland Avenue
Los Angeles, CA 90019
Phone: 213-936-5729

Cheatsheet Products, Inc.
P.O. Box 111368
Pittsburgh, PA 15238
Phone: 412-781-1551

Classic Image, Inc.
c/o Waxberg & Associates, Inc.
Shrewsbury Executive Center
1030 Broad Street
Shrewsbury, NJ 07701
Phone: 201-389-3633

Clinical Interviews
P.O. Box 69
Willard, NY 14558
Phone: 607-869-5955

Computer Friends
6415 SW Canyon Court, Suite #10
Portland, OR 97221
Phone: 503-297-2321

Free Spirit Software Inc.
5836 S. Mozart
Chicago, IL 60629
Phone: 312-476-3640

Howard W. Sams & Co.
4300 W. 62nd Street
Indianapolis, IN 46268
Phone: 317-298-5400

InfoBooks
P.O. Box 1018
Santa Monica, CA 90406
Phone: 213-470-6786

Juki Office Machine Corp.
Printer Division
20437 South Western Ave.
Torrance, CA 90501
Phone: 800-325-6134
(in CA 800-435-6315)

Knight-Ridder Newspapers, Inc.
One Herald Plaza
Miami, FL 33101
Phone: 305-376-3838

Micro R & D, Inc.
3333 S. Wadsworth Blvd., #A104
Lakewood, CO 80227
Phone: 303-985-4077

NoSync Development Corp.
#103-2334 Marpole Ave.
Port Coquitlam, B.C.
Canada V3C 2A2
Phone: 604-464-2983

Nu-Age Software
2311 28th Street North
St. Petersburg, FL 33713
Phone: 813-323-8389

Okidata
532 Fellowship Road
Mt. Laurel, NJ 08054
Phone: 609-235-2600

Prelco
14202 Gale Street
Tustin, CA 92680

Prism Software
401 Lake Air Dr., Suite D
Waco, TX 76710
Phone: 817-757-4031

PSIDAC
7326 N. Atlantic
Portland, OR 97217
Phone: 503-289-6254

SourceView Software Int'l
835 Castro Street
Martinez, CA 94553
Phone: 415-228-6220

Spectrum HoloByte Inc.
1050 Walnut, Suite 325
Boulder, CO 80302
Phone: 303-443-0191

Starpoint Software
122 South Broadway
Yreka, CA 96097
Phone: 916-842-6183

SubLOGIC Corporation
713 Edgebrook Drive
Champaign, IL 61820
Phone: 217-359-8482; orders 800-637-4983 except in IL, AK, HI

Tab Books, Inc.
Blue Ridge Summit, PA 17214
Phone: 717-794-2191

The Avalon Hill Game Co.
Microcomputer Games Division
4517 Harford Road
Baltimore, MD 21214
Phone: 301-254-9200

Tidal Bore Software
230 Pleasant Street
Truro, NS
Canada B2N 3S8
Phone: 902-895-4563

Timeworks
444 Lake Cook Road
Deerfield, IL 60015
Phone: 312-948-9200

3M
P.O. Box 33600
St. Paul, MN 55133-3600
Phone: 612-736-2355

PROGRAM LISTINGS

Attention new *Ahoy!* readers! You must read the following information very carefully prior to typing in programs listed in *Ahoy!* Certain Commodore characters, commands, and strings of characters and commands will appear in a special format. Follow the instructions and listing guide on this page.

On the following pages you'll find several programs that you can enter on your Commodore computer. But before doing so, read this entire page carefully.

To insure clear reproductions, *Ahoy!*'s program listings are generated on a daisy wheel printer, incapable of printing the commands and graphic characters used in Commodore programs. These are therefore represented by various codes enclosed in brackets [ ]. For example: the SHIFT CLR/HOME command is represented onscreen by a heart . The code we use in our listings is [CLEAR]. The chart below lists all such codes which you'll encounter in our listings, except for one other special case.

The other special case is the COMMODORE and SHIFT characters. On the front of most keys are two symbols. The symbol on the left is obtained by pressing that key while holding down the COMMODORE key; the symbol on the right, by pressing that key while holding down the SHIFT key. COMMODORE and SHIFT characters are represented in our listings by a lower-case "s" or "c" followed by the symbol of the key you must hit. COMMODORE J, for example, is represented by [c J], and SHIFT J by [s J].

Additionally, any character that occurs more than two times in a row will be displayed by a coded listing. For example, [3 "[LEFT]"] would be 3 CuRSoR left commands in a row, [5 "[s EP]"] would be 5 SHIFTed English Pounds, and so on. Multiple blank spaces will be noted in similar fashion: e.g., 22 spaces as [22 " "].

Sometimes you'll find a program line that's too long for the computer to accept (C-64 lines are a maximum of 80 characters, or 2 screen lines long; VIC 20 lines, a maximum of 88 characters, or 4 screen lines). To enter these lines, refer to the *BASIC Command Abbreviations Appendix* in your User Manual.

On the next page you'll find our *Bug Repellent* programs for the C-128 and C-64. The version appropriate for your machine will help you proofread our programs after you type them. (Please note: the *Bug Repellent* line codes that follow each program line, in the whited-out area, should *not* be typed in. See the instructions preceding each program.)

Also on the following page you will find *Flankspeed*, our ML entry program, and instructions on its use. □

Call *Ahoy!* at 212-239-0855 with any problems.

When You See	It Means	You Type	You Will See
[CLEAR]	Screen Clear	SHIFT CLR/HOME	
[HOME]	Home	CLR/HOME	
[UP]	Cursor Up	SHIFT ↑CRSR↓	
[DOWN]	Cursor Down	↑CRSR↓	
[LEFT]	Cursor Left	SHIFT ←CRSR→	
[RIGHT]	Cursor Right	←CRSR→	
[SS]	Shifted Space	SHIFT Space	
[INSERT]	Insert	SHIFT INST/DEL	
[DEL]	Delete	INST/DEL	
[RVSON]	Reverse On	CNTRL 9	
[RVSOFF]	Reverse Off	CNTRL 0	
[UPARROW]	Up Arrow	↑	
[BACKARROW]	Back Arrow	←	
[PI]	PI	π	
[EP]	English Pound	£	

When You See	It Means	You Type	You Will See
[BLACK]	Black	CNTRL 1	
[WHITE]	White	CNTRL 2	
[RED]	Red	CNTRL 3	
[CYAN]	Cyan	CNTRL 4	
[PURPLE]	Purple	CNTRL 5	
[GREEN]	Green	CNTRL 6	
[BLUE]	Blue	CNTRL 7	
[YELLOW]	Yellow	CNTRL 8	
[F1]	Function 1	F1	
[F2]	Function 2	SHIFT F1	
[F3]	Function 3	F3	
[F4]	Function 4	SHIFT F3	
[F5]	Function 5	F5	
[F6]	Function 6	SHIFT F5	
[F7]	Function 7	F7	
[F8]	Function 8	SHIFT F7	

BUG REPELLENT By MICHAEL KLEINERT and DAVID BARRON

Bug Repellent is a checksum program used for proofreading BASIC listings typed in from *Ahoy!* magazine. For each program line you enter, *Bug Repellent* will produce a two-letter code that should match the code listed beside that line in the magazine.

Type in, save, and run the *Bug Repellent*. (If you have a C-64, type in the C-64 version. If you have a C-128, you will need to type in the C-64 version for use with C-64 programs, and the C-128 version for use with C-128 programs.) If you have typed in *Bug Repellent* properly, you will get the message BUG REPELLENT INSTALLED; otherwise you will get an error message. If you get an error message, double check the *Bug Repellent* program for typing mistakes. Type NEW and hit RETURN. Then type in and save, or load, the *Ahoy!* program you wish to check. Type in SYS 49152 for the C-64 version or SYS 3072 for the C-128 version and hit RETURN (this will begin execution of *Bug Repellent*). You will see the prompt SCREEN OR PRINTER ? Hit S if you want the codes listed on the screen, or P if you want them listed on the printer. To pause the listing depress and hold the SHIFT key.

Compare the codes your machine generates to those listed to the right of the corresponding program lines. If you spot a difference, that line contains an error. Write down the numbers of the lines where the contradictions occur. LIST each line, locate the errors, and correct them.

COMMODORE 64 VERSION

```
·100 FOR X = 49152 TO 49488:READY:S=S+Y           AB
·110 IF Y<0 OR Y>255 THEN 130                     EA
·120 POKE X,Y:NEXT:GOTO140                        ID
·130 PRINT"[CLEAR][DOWN]**ERROR**":PRINT"[DOWN
 ]PLEASE CHECK LINE"PEEK(64)*256+PEEK(63):END     ID
·140 IF S<>44677 THEN PRINT"[CLEAR][DOWN]**ERR
 OR**":PRINT"[DOWN]PLEASE CHECK DATA LINES 170
 -500":END                                        HJ
·150 PRINT"[CLEAR]":POKE53280,0:POKE53281,6:PO
 KE646,1                                          NP
·160 PRINT"[RVSON][6" "]C-64 BUG REPELLENT INS
 TALLED[6" "]"                                    LF
·170 DATA32,161,192,165,43,133,251,165,44,133     DL
·180 DATA252,160,0,132,254,32,37,193,234,177      DB
·190 DATA251,208,3,76,138,192,230,251,208,2       OF
·200 DATA230,252,76,43,192,76,73,78,69,32         KN
·210 DATA35,32,0,169,35,160,192,32,30,171         CA
·220 DATA160,0,177,251,170,230,251,208,2,230      CE
·230 DATA252,177,251,32,205,189,169,58,32,210     JE
·240 DATA255,169,0,133,253,230,254,32,37,193      CL
·250 DATA234,165,253,160,0,76,13,193,133,253      NB
·260 DATA177,251,208,237,165,253,41,240,74,74     MB
·270 DATA74,74,24,105,65,32,210,255,165,253       EP
·280 DATA 41,15,24,105,65,32,210,255,169,13       GH
·290 DATA32,220,192,230,63,208,2,230,64,230       AN
·300 DATA251,208,2,230,252,76,11,192,169,153      NG
·310 DATA160,192,32,30,171,166,63,165,64,76       BF
·320 DATA231,192,96,76,73,78,69,83,58,32          EP
·330 DATA0,169,247,160,192,32,30,171,169,3        PJ
·340 DATA133,254,32,228,255,201,83,240,6,201      FK
·350 DATA80,208,245,230,254,32,210,255,169,4      FL
·360 DATA166,254,160,255,32,186,255,169,0,133     CL
·370 DATA63,133,64,133,2,32,189,255,32,192        GC
·380 DATA255,166,254,32,201,255,76,73,193,96      NN
·390 DATA32,210,255,173,141,2,41,1,208,249        NH
·400 DATA96,32,205,189,169,13,32,210,255,32       IM
·410 DATA204,255,169,4,76,195,255,147,83,67       KC
·420 DATA82,69,69,78,32,79,82,32,80,82            DC
·430 DATA 73,78,84,69,82,32,63,32,0,76            ML
·440 DATA44,193,234,177,251,201,32,240,6,138      GN
·450 DATA113,251,69,254,170,138,76,88,192,0       JK
·460 DATA0,0,0,230,251,208,2,230,252,96           NA
·470 DATA170,177,251,201,34,208,6,165,2,73        DM
·480 DATA255,133,2,165,2,208,218,177,251,201      JA
·490 DATA32,208,212,198,254,76,29,193,0,169       FM
·500 DATA13,76,210,255,0,0,0                      PA
```

COMMODORE 128 VERSION

```
·100 FAST:FOR X = 3072 TO 3520:READ Y:POKE X,Y
 :S=S+Y:TRAP110:NEXT:SLOW                         IH
·110 SLOW:IF S<>49057 THEN PRINT"[CLEAR][DOWN]
**ERROR**":PRINT"[DOWN]PLEASE CHECK DATA LINE
S 140-390":END                                    JA
·120 PRINT"[CLEAR][DOWN]  C-128 BUG REPELLENT
 INSTALLED"                                       II
·130 PRINT"[4" "]TYPE SYS 3072 TO ACTIVATE"      IN
·140 DATA 32,161,12,165,45,133,251,165,46,133,
 252,160,0,132,254,32,37                          OF
·150 DATA 13,234,177,251,208,3,76,138,12,230,2
 51,208,2,230,252,76,43                           NC
·160 DATA 12,76,73,78,69,32,35,32,0,169,35,160
 ,12,32,80,13,160,0,177                           OL
·170 DATA 251,170,230,251,208,2,230,252,177,25
 1,32,89,13,169,58,32,98                          EF
·180 DATA 13,169,0,133,253,230,254,32,37,13,23
 4,165,253,160,0,76,13                            JO
·190 DATA 13,133,253,177,251,208,237,165,253,4
 1,240,74,74,74,74,24                             LC
·200 DATA 105,65,32,98,13,165,253,41,15,24,105
 ,65,32,98,13,169,13,32                           DE
·210 DATA 220,12,230,65,208,2,230,66,230,251,2
 08,2,230,252,76,11,12                            GM
·220 DATA 169,153,160,12,32,80,13,166,65,165,6
 6,76,231,12,96,76,73,78                          CP
·230 DATA 69,83,58,32,0,169,247,160,12,32,80,1
 3,169,3,133,254,32,107                           HC
·240 DATA 13,201,83,240,6,201,80,208,245,230,2
 54,32,98,13,169,4,166                            GK
·250 DATA 254,160,255,32,116,13,169,0,133,65,1
 33,66,133,250,32,125,13                          LB
·260 DATA 32,134,13,166,254,32,143,13,76,73,13
 ,96,32,98,13,165,211                             JF
·270 DATA 234,41,1,208,249,96,32,89,13,169,13,
 32,98,13,32,152,13,169,4                         GD
·280 DATA 76,161,13,147,83,67,82,69,69,78,32,7
 9,82,32,80,82,73,78,84,69                        PL
·290 DATA 82,32,63,32,0,76,44,13,234,177,251,2
 01,32,240,6,138,113,251,69                       OK
·300 DATA 254,170,138,76,88,12,0,0,0,0,230,251
 ,208,2,230,252,96,170,177                        FJ
·310 DATA 251,201,34,208,6,165,250,73,255,133,
 250,165,250,208,218,177                          GA
·320 DATA 251,201,32,208,212,198,254,76,29,13,
 0,169,13,76,98,13,0,0,32                         FI
·330 DATA 170,13,32,226,85,76,180,13,32,170,13
 ,32,50,142,76,180,13,32                          OF
·340 DATA 170,13,32,210,255,76,180,13,32,170,1
 3,32,228,255,76,180,13,32                        AK
·350 DATA 170,13,32,186,255,76,180,13,32,170,1
 3,32,189,255                                     BP
·360 DATA 76,180,13,32,170,13,32,192,255,76,18
 0,13,32,170,13                                   FP
·370 DATA 32,201,255,76,180,13,32,170,13,32,20
 4,255,76,180,13,32,170                           ID
·380 DATA 13,32,195,255,76,180,13,133,67,169,0
 ,141,0,255,165,67,96                             BJ
·390 DATA 133,67,169,0,141,1,255,165,67,96,0,0
 ,0                                               IF
```

FLANKSPEED FOR THE C-64 By GORDON F. WHEAT

Flankspeed will allow you to enter machine language *Ahoy!* programs without any mistakes. Once you have typed the program in, save it for future use. While entering an ML program with *Flankspeed* there is no need to enter spaces or hit the carriage return. This is all done automatically. If you make an error in a line a bell will ring and you will be asked to enter it again. To LOAD in a program Saved with *Flankspeed* use LOAD "name",1,1 for tape, or LOAD "name",8,1 for disk. The function keys may be used after the starting and ending addresses have been entered.

f1 – SAVEs what you have entered so far.
f3 – LOADs in a program worked on previously.
f5 – To continue on a line you stopped on after LOADing in the previous saved work.
f7 – Scans through the program to locate a particular line, or to find out where you stopped the last time you entered the program.
f7 temporarily freezes the output as well.

```
·100 POKE53280,12:POKE53281,11                                  LL
·105 PRINT"[CLEAR][c 8][RVSON][15" "]FLANKSPEED[15" "]";        ED
·110 PRINT"[RVSON][5" "]MISTAKEPROOF ML ENTRY PROGRAM[6" "
 ]"                                                             MC
·115 PRINT"[RVSON][9" "]CREATED BY G. F. WHEAT[9" "]"           DM
·120 PRINT"[RVSON][3" "]COPR. 1984, ION INTERNATIONAL INC.
 [3" "]"                                                        DH
·125 FORA=54272TO54296:POKEA,0:NEXT                             IM
·130 POKE54272,4:POKE54273,48:POKE54277,0:POKE54278,249:PO
 KE54296,15                                                     NH
·135 FORA=680TO699:READB:POKEA,B:NEXT                           KO
·140 DATA169,251,166,253,164,254,32,216,255,96                  HJ
·145 DATA169,0,166,251,164,252,32,213,255,96                    JB
·150 B$="STARTING ADDRESS IN HEX":GOSUB430:AD=B:SR=B            HC
·155 GOSUB480:IFB=0THEN150                                      FO
·160 POKE251,T(4)+T(3)*16:POKE252,T(2)+T(1)*16                  KE
·165 B$="ENDING ADDRESS IN HEX":GOSUB430:EN=B                   IF
·170 GOSUB470:IFB=0THEN150                                      FP
·175 POKE254,T(2)+T(1)*16:B=T(4)+1+T(3)*16                      MN
·180 IFB>255THENB=B-255:POKE254,PEEK(254)+1                     GE
·185 POKE253,B:PRINT                                            HN
·190 REM  GET HEX LINE                                          IL
·195 GOSUB495:PRINT": [c P][LEFT]";:FORA=0TO8                   FG
·200 FORB=0TO1:GOTO250                                          MD
·205 NEXTB                                                      ME
·210 A%(A)=T(1)+T(0)*16:IFAD+A-1=ENTHEN340                      LH
·215 PRINT" [c P][LEFT]";                                       IK
·220 NEXTA:T=AD-(INT(AD/256)*256):PRINT" "                      PD
·225 FORA=0TO7:T=T+A%(A):IFT>255THENT=T-255                     LK
·230 NEXT                                                       IA
·235 IFA%(8)<>TTHENGOSUB375:GOTO195                             FK
·240 FORA=0TO7:POKEAD+A,A%(A):NEXT:AD=AD+8:GOTO195              MN
·245 REM    GET HEX INPUT                                       AB
·250 GETA$:IFA$=""THEN250                                       HO
·255 IFA$=CHR$(20)THEN305                                       GC
·260 IFA$=CHR$(133)THEN535                                      MD
·265 IFA$=CHR$(134)THEN560                                      KF
·270 IFA$=CHR$(135)THENPRINT" ":GOTO620                         GE
·275 IFA$=CHR$(136)THENPRINT" ":GOTO635                         BJ
·280 IFA$>"@"ANDA$<"G"THENT(B)=ASC(A$)-55:GOTO295               GM
·285 IFA$>"/"ANDA$<":"THENT(B)=ASC(A$)-48:GOTO295               LE
·290 GOSUB415:GOTO250                                           LL
·295 PRINTA$"[c P][LEFT]";                                      OA
·300 GOTO205                                                    CG
·305 IFA>0THEN320                                               OP
·310 A=-1:IFB=1THEN330                                          OB
·315 GOTO220                                                    CJ
·320 IFB=0THENPRINTCHR$(20);CHR$(20);:A=A-1                     HG
·325 A=A-1                                                      BE
·330 PRINTCHR$(20);:GOTO220                                     KH
·335 REM LAST LINE                                              AD
·340 PRINT" ":T=AD-(INT(AD/256)*256)                            GJ
·345 FORB=0TOA-1:T=T+A%(B):IFT>255THENT=T-255                   PL
·350 NEXT                                                       IA
·355 IFA%(A)<>TTHENGOSUB375:GOTO195                             KF
·360 FORB=0TOA-1:POKEAD+B,A%(B):NEXT                            HN
·365 PRINT:PRINT"YOU ARE FINISHED!":GOTO535                     ON
·370 REM BELL AND ERROR MESSAGES                                FL
·375 PRINT:PRINT"LINE ENTERED INCORRECTLY":PRINT:GOTO415        DH
·380 PRINT:PRINT"INPUT A 4 DIGIT HEX VALUE!":GOTO415            JA
·385 PRINT:PRINT"ENDING IS LESS THAN STARTING!":B=0:GOTO41
 5                                                              HD
·390 PRINT:PRINT"ADDRESS NOT WITHIN SPECIFIED RANGE!":B=0:
 GOTO415                                                        AG
·395 PRINT:PRINT"NOT ZERO PAGE OR ROM!":B=0:GOTO415             KN
·400 PRINT"?ERROR IN SAVE":GOTO415                              EI
·405 PRINT"?ERROR IN LOAD":GOTO415                              GL
·410 PRINT:PRINT:PRINT"END OF ML AREA":PRINT                    PG
·415 POKE54276,17:POKE54276,16:RETURN                           BH
·420 OPEN15,8,15:INPUT#15,A,A$:CLOSE15:PRINTA$:RETURN           IM
·425 REM GET FOUR DIGIT HEX                                     PC
·430 PRINT:PRINTB$;:INPUTT$                                     GM
·435 IFLEN(T$)<>4THENGOSUB380:GOTO430                           II
·440 FORA=1TO4:A$=MID$(T$,A,1):GOSUB450:IFT(A)=16THENGOSUB
 380:GOTO430                                                    AD
·445 NEXT:B=(T(1)*4096)+(T(2)*256)+(T(3)*16)+T(4):RETURN        GF
·450 IFA$>"@"ANDA$<"G"THENT(A)=ASC(A$)-55:RETURN                EH
·455 IFA$>"/"ANDA$<":"THENT(A)=ASC(A$)-48:RETURN                KP
·460 T(A)=16:RETURN                                             NP
·465 REM ADRESS CHECK                                           LI
·470 IFAD>ENTHEN385                                             MI
·475 IFB<SRORB>ENTHEN390                                        MG
·480 IFB<256OR(B>40960ANDB<49152)ORB>53247THEN395               MI
·485 RETURN                                                     IM
·490 REM ADDRESS TO HEX                                         EB
·495 AC=AD:A=4096:GOSUB520                                      HG
·500 A=256:GOSUB520                                             CE
·505 A=16:GOSUB520                                              PN
·510 A=1:GOSUB520                                               MJ
·515 RETURN                                                     IM
·520 T=INT(AC/A):IFT>9THENA$=CHR$(T+55):GOTO530                 CJ
·525 A$=CHR$(T+48)                                              JP
·530 PRINTA$;:AC=AC-A*T:RETURN                                  AC
·535 A$="**SAVE**":GOSUB585                                     AI
·540 OPEN1,T,1,A$:SYS680:CLOSE1                                 LH
·545 IFST=0THENEND                                              EO
·550 GOSUB400:IFT=8THENGOSUB420                                 FJ
·555 GOTO535                                                    FF
·560 A$="**LOAD**":GOSUB585                                     AB
·565 OPEN1,T,0,A$:SYS690:CLOSE1                                 MF
·570 IFST=64THEN195                                             JH
·575 GOSUB405:IFT=8THENGOSUB420                                 CM
·580 GOTO560                                                    FO
·585 PRINT" ":PRINTTAB(14)A$                                    FG
·590 PRINT:A$="":INPUT"FILENAME";A$                             OM
·595 IFA$=""THEN590                                             GF
·600 PRINT:PRINT"TAPE OR DISK?":PRINT                           DF
·605 GETB$:T=1:IFB$="D"THENT=8:A$="@0:"+A$:RETURN               IG
·610 IFB$<>"T"THEN605                                           FN
·615 RETURN                                                     IM
·620 B$="CONTINUE FROM ADDRESS":GOSUB430:AD=B                   DK
·625 GOSUB475:IFB=0THEN620                                      MA
·630 PRINT:GOTO195                                              OI
·635 B$="BEGIN SCAN AT ADDRESS":GOSUB430:AD=B                   FH
·640 GOSUB475:IFB=0THEN635                                      NK
·645 PRINT:GOTO670                                              DI
·650 FORB=0TO7:AC=PEEK(AD+B):GOSUB505:IFAD+B=ENTHENAD=SR:G
 OSUB410:GOTO195                                                BK
·655 PRINT" ";:NEXTB                                            EC
·660 PRINT:AD=AD+8                                              GN
·665 GETB$:IFB$=CHR$(136)THEN195                                MN
·670 GOSUB495:PRINT": ";:GOTO650                                JD
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 83 and 84 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

NOW HEAR THIS
FROM PAGE 67

Use of an assembler required for entry! See introductory article.

MUSIC.S

```
*
* MUSIC2
*
            ORG     $8000
*
SFDX        EQU     $CB
*
CINV        EQU     $314
USERADD     EQU     $311
*
GETIN       EQU     $FFE4
*
SIGVOL      EQU     $D418
ATDCY1      EQU     $D405
PWHI1       EQU     $D403
PWLO1       EQU     $D402
SUREL1      EQU     $D406
FREHI1      EQU     $D401
FRELO1      EQU     $D400
VCREG1      EQU     $D404
*
TIMER       EQU     $FB
CHAR        EQU     TIMER+1
*
            JMP     INIT
*
MATRIX      DFB     62,10,9
            DFB     13,18,17
            DFB     21,22,26
            DFB     29,30,34
            DFB     33,37,38
            DFB     42,45,46
            DFB     50,49,53
*
HIFREQ      DFB     13,14,14
            DFB     15,16,17
            DFB     18,19,21
            DFB     22,23,25
            DFB     26,28,29
            DFB     31,33,35
            DFB     37,39,42
*
LOFREQ      DFB     78,24,239
            DFB     210,195
            DFB     195,209
            DFB     239,31,96
            DFB     181,30
            DFB     156,49
            DFB     223,165
            DFB     135,134
            DFB     162,223
            DFB     62
*
* CLEAR SOUND REGISTERS
*
*
INIT        LDA     #0
            LDX     #$18
CLOOP       STA     $D400,X
            DEX
            BNE     CLOOP
*
* SET UP TIMER
*
            LDA     #60
            STA     TIMER
*
* SET UP INTERRUPT
*
            LDA     CINV
            STA     USERADD
            LDA     CINV+1
            STA     USERADD+1
            SEI
            LDA     #<WAIT
            STA     CINV
            LDA     #>WAIT
            STA     CINV+1
            CLI
*
* SET REGISTERS
*
            LDA     #15
            STA     SIGVOL
            LDA     #9
            STA     ATDCY1
            LDA     #0
            STA     SUREL1
            STA     PWHI1
            LDA     #255
            STA     PWLO1
            LDA     #64
            STA     VCREG1
*
GETKEY      LDA     SFDX
            CMP     #64
            BNE     SKIP
            LDA     #0
            STA     CHAR
            JMP     GETKEY
*
SKIP        LDX     #20
CHECK       CMP     MATRIX,X
            BEQ     PLAY
            DEX
            BPL     CHECK
            JMP     GETKEY
*
PLAY        CMP     CHAR
            BNE     CONT
            JMP     GETKEY
*
CONT        STA     CHAR
            LDA     #60
            STA     TIMER
            LDA     #64
            STA     VCREG1
            LDA     HIFREQ,X
            STA     FREHI1
            LDA     LOFREQ,X
            STA     FRELO1
            LDA     #65
            STA     VCREG1
            JMP     GETKEY
*
WAIT        LDX     TIMER
            DEX
            BNE     RETURN
            LDA     #64
            STA     VCREG1
            LDX     #0
RETURN      STX     TIMER
            JMP     (USERADD)
```

GOT A MATCH
FROM PAGE 30

```
·5 REM"[6" "][c A][14"[s *]"][c S]                  GC
·6 REM"[6" "][s -] GOT A MATCH? [s -]               FC
·7 REM"[6" "][c Z][14"[s *]"][c X]                  FO
·8 REM"[5" "]BY  WALTER E. MEYERS                   GB
·9 REM"  403 CARRIAGE LANE, CARY, NC                HF
·10 POKE 53269,0:POKE 53272,21:POKE 648,4
 :POKE 56576,PEEK(56576)OR 3:GOTO 100               BJ
·20 POKE 198,0:WAIT 198,1:I=PEEK(631):POK
 E 198,0:RETURN                                     JE
·30 POKE S+24,15:POKE S+5,45:POKE S+6,165
 :POKE S+4,33:POKE S+1,6:POKE S,5                   PJ
```

```
•35 FOR T=1 TO 100:NEXT:POKE S+4,32:POKE
S+4,16:RETURN                                 OE
•40 POKE S+24,15:POKE S+6,247:POKE S+4,17
:POKE S+1,40:GOTO 35                          FA
•50 POKE 781,LN:POKE 782,COL:POKE 783,0:S
YS 65520:RETURN                               DH
•60 FOR I=S TO S+24:POKE I,0:NEXT:RETURN      BG
•70 PRINT"[CLEAR]" PL$ N$(K):RETURN           FN
•80 POKE V+6,144:POKE V+16,0:POKE V+21,8:
RETURN                                        JD
•90 N=INT(RND(0)*D+1):RETURN                  PC
•99 REM          INITIALIZE                   JN
•100 SC=53281:BO=53280:POKE SC,15:POKE BO
,15:PRINT"[CLEAR][DOWN][DOWN][c 4][5" "]
ONE MOMENT, PLEASE."                          NC
•110 FOR MUSIC=1 TO 124:READ A:NEXT           JK
•120 FOR TYPE=49152 TO 49184:READ A:POKE
TY,A:NEXT                                     AI
•130 FOR SPRITE=49216 TO 49599:READ A:POK
E SP,A:NEXT                                   EH
•140 FOR JOYSTICK=49600 TO 49736:READ A:P
OKE JO,A:NEXT                                 KB
•150 V=53248:POKE V+23,53:POKE V+29,48:FO
R I=1 TO 6:POKE 52215+I,I:NEXT                IA
•160 POKE V,255:POKE V+2,255:POKE V+4,254
:POKE V+8,242:POKE V+9,194                    ML
•170 POKE V+10,245:POKE V+11,236:POKE V+3
9,7:POKE V+40,7:POKE V+41,8:POKE V+42,7       PL
•180 POKE V+43,8:POKE V+44,14:S=54272         KH
•190 DIM T$(19):P=2:GOTO 1000                 CK
•198 :                                        DI
•199 REM  INSTRUCTIONS                        IP
•200 PRINT"[CLEAR][4"[DOWN]"][c 4][s B]ER
ZERKONS COME IN FOUR DIFFERENT KINDS,"SP
C(6)"AND IN A ";                              CL
•210 PRINT"VARIETY OF COLORS.":PRINT"[DOW
N][s H]ERE THEY ARE:":PRINT:PRINTTAB(2)
NM$(1);                                       PN
•220 PRINTTAB(13) NM$(2) TAB(22) NM$(3) T
AB(32) NM$(4):PRINTTAB(4) BZ$(1);             EH
•230 PRINTTAB(14) BZ$(2) SPC(8) BZ$(3) SP
C(8) BZ$(4):PRINT:PRINT:PRINT                 IF
•240 PRINT SK$ " [s H]IT ANY KEY WHEN Y'A
LL'RE DONE"SPC(10)"STUDYIN' AND ARE READ
Y";                                           MP
•250 PRINT" TO PLAY.":GOSUB 20                CB
•398 :                                        DI
•399 REM  INPUT                               GG
•400 PRINT"[CLEAR][DOWN][DOWN][c 4][s H]O
W MANY FOLKS'LL BE PLAYIN'" NG$:SU$="":C
N$="":VB$="IS"                                IG
•410 GOSUB 20:NP=I-48:IF(NP<1)OR(NP>9)THE
N 410                                         DF
•420 PRINT"[DOWN][DOWN][s N]UMBER OF PLAY
ERS ="NP:PRINT:PRINT                          ID
•430 PRINT SK$ "[s P]ICK A DIFFICULTY LEV
EL BY HITTING[6"[RIGHT]"]A NUMBER KEY.":
PRINT                                         JL
•440 PRINTTAB(9)"[BLACK][s E]ASY"SPC(17)"
[s H]ARD" SPC(15)"[RED][c Q][s *][s *][s
+][s *][s *][s +][s *][s *][s +][s *][s
*][s +][s *][s *][s +][s *][s *][s +][s
*][s *][s +][s *][s *][c W]"                  GK
•450 PRINTTAB(9)"[BLACK]1  2  3  4  5  6
 7  8  9"                                     II
•460 GOSUB 20:IF (I<49)OR(I>57) THEN 460      OO
•470 I=I-48:D(1)=I+3:I=60-(I*5):CY=INT(2.
5*I)                                          CO
•480 PRINT"[DOWN][DOWN]"SK$ "[s H]IT ANY
KEY WHEN YOU'RE READY TO [7"[RIGHT]"]STA
RT.":GOSUB20                                  HA
•498 :                                        DI
•499 REM  MAIN LOOP                           FA
•500 C$="1[BLACK]2[WHITE]3[RED]4[PURPLE]5
[GREEN]6[BLUE]":FOR K=1 TO NP:POKE BO,0:
POKE SC,15:FOR I=1 TO 4:D=D(1)                JE
•510 GOSUB 90:Z(I)=N:IN(I)=20-Z(I):D=6:GO
SUB 90:Z$(I)=MID$(C$,(N*2)-1,2)               CE
•520 RZ$(I)=RIGHT$(Z$(I),1):NEXT:PRINT"[R
ED]":GOSUB 70:PRINT:PRINT:FOR I=1 TO 4        DN
•530 PRINTTAB(IN(I));:FOR J=1TOZ(I):PRINT
 RZ$(I) BZ$(I);:NEXT:PRINT:PRINT:NEXT         OE
•540 FOR I=1 TO 4:PRINT:NEXT:LN=17:COL=30
:GOSUB 50:PRINT M$:POKE V+21,53               BF
•550 VE=144:FOR I=1 TO 15:POKE V+1,VE+2:P
OKE V+5,VE:FOR J=1 TO 10:POKE 52216,P         EO
•560 P=3-P:FOR T=1 TO CY:NEXT:NEXT:VE=VE+
1:NEXT:POKE V+21,0                            AE
•570 POKE SC,0:PRINT"[CLEAR][CYAN]":GOSUB
 70:PRINT"[HOME]"TAB(19)"[YELLOW][RVSOFF
][s M]OVE THE POINTER TO"                     GN
•580 PRINTTAB(19)"YOUR ANSWER AND HIT":PR
INTTAB(19)"THE FIRE BUTTON.[CYAN]"            NJ
•590 PS$=STR$(PS(K)*10):PRINT"  [RVSON]
SCORE "PS$"[RVSON]  [c 8]":PRINT              FI
•600 FOR I=1 TO 4:LN=9:COL=5:GOSUB 50:PRI
NT"[s H]OW MANY " NM$(I) "?[3" "]":GOSUB
80                                            MC
•610 PRINT "[DOWN] 1  2  3  4  5  6  7  8
  9 10 11 12":POKE V+7,147:POKE 49152,24      AF
•620 POKE 49153,24:POKE 49154,34:POKE 491
55,10:POKE 49156,240:SYS 49600                IF
•630 IF PEEK(V+16)=8 THEN AN=INT(PEEK(V+6
)/34)+11:GOTO 650 '                           PA
•640 AN=INT((PEEK(V+6)-11)/24)+1              LG
•650 IF AN=Z(I) THEN GOSUB 40:PS(K)=PS(K)
+1:GOTO 670                                   GJ
•660 GOSUB 30                                 BC
•670 GOSUB 80:LN=15:COL=5:GOSUB 50:PRINT"
[s W]HAT COLOR?"                              DG
•680 PRINT"[DOWN]BLACK  WHITE[3" "]RED  P
URPLE  GREEN  BLUE":POKE V+7,197:POKE 49
152,56                                        AF
•690 POKE 49153,32:POKE 49154,56:POKE 491
55,0:POKE 49156,200:SYS 49600                 LP
•700 HO=PEEK(V+6)-24:IF PEEK(V+16)=8 THEN
```

```
 HO=HO+255                                HD
•710 AN=INT(HO/52+1):IF AN=VAL(Z$(I)) THE
 N GOSUB 40:PS(K)=PS(K)+1:GOTO 730        PE
•720 GOSUB 30                             BC
•730 NEXT:POKE V+21,0:NEXT:POKE V+21,0:GM
 =GM+1:IF GM<6 THEN 500                   CK
•798 :                                    DI
•799 REM    PRINT SCORES, NEW/END GAME    CJ
•800 PRINT"[CLEAR][BLUE]":POKE SC,15:POKE
 BO,15:LN=2:COL=9:GOSUB 50:PRINT ES$:PRI
 NT                                       HE
•805 FOR I=1 TO NP:PRINTTAB(13)"[c 4][s P
 ]LAYER" I "[LEFT]:" PS(I)*10:X(I)=PS(I):
 NEXT                                     ML
•810 FOR J=1 TO NP:FOR I=1 TO NP:IF X(J)<
 PS(I) THEN X(J)=0                        JL
•820 NEXT:NEXT                            EF
•825 FOR J=1 TO NP:FOR I=1 TO NP          PL
•830 IF X(J)<>0THEN IF J<>ITHEN IF X(J)=P
 S(I)THEN SU$="S":CN$="AND":VB$="[3"[LEFT
 ]"]ARE"                                  KD
•840 NEXT:NEXT:PRINT"[DOWN][DOWN][s P]LAY
 ER" SU$;                                 OB
•845 FOR I=1 TO NP:IF X(I)<>0 THEN PRINT
 I;CN$;                                   NO
•850 NEXT:PRINT VB$" THE WINNER" SU$ "!"  JP
•860 PRINT"[DOWN]  [s H]IT [RED][s Y][c 4
 ] IF Y'ALL WANT TO PLAY AGAIN OR" R$ TAB
 (9)"ANY OTHER KEY";                      FB
•870 PRINT" TO END.":GOSUB 20:IF I=89 THE
 N GM=0:NG$=" THIS TIME?":GOTO 400        DL
•880 GOSUB 60:POKE 53272,21:POKE 648,4:PO
 KE 56576,PEEK(56576) OR 3:PRINT"[CLEAR][
 c 7]"                                    OO
•890 POKE SC,6:POKE BO,14:CLR:NEW:END     FH
•998 :                                    DI
•999 REM  LOAD FONT                       DG
•1000 POKE 56334,PEEK(56334) AND 254:POKE
  1,PEEK(1) AND 251:SYS 49152             ID
•1010 POKE 1,PEEK(1) OR 4:POKE 56334,PEEK
 (56334) OR 1                             AH
•1020 READ A:IF A<0 THEN 1040             KI
•1030 FOR I=0 TO 7:READ B:POKE 61440+(A*8
 )+I,B:NEXT:GOTO 1020                     OC
•1040 FOR IRQ=53236 TO 53245:READ A:POKE
 IRQ,A:NEXT                               EG
•1050 POKE 53246,PEEK(792):POKE 53247,PEE
 K(793):POKE 792,244:POKE 793,207         KK
•1098 :                                   DI
•1099 REM  STRINGS                        AD
•1100 T0$="[RVSON][c 2][c M][15" "][WHITE
 ][c B]":T1$="[RVSON][c 2][c M]  ":T2$="[
 3" "][WHITE] [RVSOFF][c 4][c K]"         KJ
•1110 T$(1)=" [s U][s I][s U][s I][c R] [
 s U][s I] ":T$(2)=" [s B][c S][3"[s B]"]
  [c Q][c W] ":T$(3)=" [s J][c X][s J][s
 K][s E] [s E][s E] "                     LF
•1120 T$(4)="[c A][c R][s I][s U][s I][c
 R][s U][s I][s A][s A]":T$(5)="[3"[s B]"
 ][c Q][c W][s B][s B] [c Q][c W]":T$(6)=
 "[6"[s E]"][s J][s K][s E][s E]"         PN
•1130 T$(7)="[3" "][c A][3"[s *]"][c S]
 ":T$(8)="  [c A][s K][s U][s *][s I][s J
 ][c S] ":T$(9)="  [s B]  [c A][s K] [s B
 ] "                                      EJ
•1140 T$(10)="  [c Z][s I] [s Q] [s U][c
 X] ":T$(11)="[3" "][c Z][3"[s *]"][c X]
  ":T$(12)="  A TALE  "                   PK
•1150 T$(13)="  OF THE  ":T$(14)=" OLD WE
 ST ":T$(15)="[10" "]":T$(16)=T$(15)      BM
•1160 T3$="[RVSON][c 2][c V][RVSOFF][15"
 "][WHITE][s @][c 4][c K]":T4$="[c C][RVS
 ON][16"[c I]"][RVSOFF][c V]"             LM
•1170 G$="[39" "]":SK$="[WHITE][c Z][s *]
 [RVSON][s Q][s Q][RVSOFF][s *][c X][DOWN
 ][4"[LEFT]"][RVSON][c F][c D][RVSOFF][RI
 GHT][RIGHT][UP][c 4]"                    MI
•1180 C1$="[GREEN][RVSON] [UP][LEFT] [UP]
 [3"[LEFT]"] [c U] [c U] [UP][5"[LEFT]"]
 [RIGHT] [RIGHT] [UP][5"[LEFT]"] [RIGHT]
 [RIGHT] [UP][3"[LEFT]"] [RIGHT] [UP][3"[
 LEFT]"] [UP][LEFT] [UP][LEFT] "          CG
•1190 C2$="[GREEN][c K][UP][RVSON][LEFT][
 c D][c I][UP][3"[LEFT]"][c I][RVSOFF][c
 K][RVSON][c K][UP][3"[LEFT]"][RVSOFF][c
 K][c K][c D][UP][LEFT][LEFT][RVSOFF][c K
 ][5"[DOWN]"]"                            BC
•1200 BZ$(1)="[RVSON]&'[DOWN][LEFT][LEFT]
 *+[UP]":BZ$(2)="[RVSON]$%[DOWN][LEFT][LE
 FT]*+[UP]":BZ$(3)="[RVSON]!#[DOWN][LEFT]
 [LEFT]*+[UP]":NM$(2)="[s M]OES"          DC
•1210 BZ$(4)="[RVSON]()[DOWN][LEFT][LEFT]
 *+[UP]":NM$(1)="[s L]ARRIES":NM$(3)="[s
 C]URLIES":NM$(4)="[s S]HEMPS"            IN
•1230 N$(1)=" [c S] [DOWN][3"[LEFT]"] [s
 B] [DOWN][3"[LEFT]"] [s E] ":N$(2)="[s U
 ][s I] [DOWN][3"[LEFT]"][s U][s K] [DOWN
 ][3"[LEFT]"][c Z][s C] "                 CE
•1240 N$(3)="[s U][s I] [DOWN][3"[LEFT]"]
 [s D][c J] [DOWN][3"[LEFT]"][s J][s K] "
 :N$(4)="[s A][s A] [DOWN][3"[LEFT]"][c Z
 ][c W] [DOWN][3"[LEFT]"] [s E] "         OH
•1250 N$(5)="[c A][s C] [DOWN][3"[LEFT]"]
 [c Z][s I] [DOWN][3"[LEFT]"][s J][s K] "
 :N$(6)="[s U][s I] [DOWN][3"[LEFT]"][c Q
 ][s I] [DOWN][3"[LEFT]"][s J][s K] "     KO
•1260 N$(7)="[c A][c S] [DOWN][3"[LEFT]"]
  [s B] [DOWN][3"[LEFT]"] [s E] ":N$(8)="
 [s U][s I] [DOWN][3"[LEFT]"][s W][c J] [
 DOWN][3"[LEFT]"][s J][s K] "             NC
•1270 N$(9)="[s U][s I] [DOWN][3"[LEFT]"]
 [s J][c W] [DOWN][3"[LEFT]"][s J][s K] "
 :NG$="?":M$="[c 2][c K][DOWN][LEFT][c K]
 [DOWN][LEFT][c K][c 4]":R$=CHR$(13)      KK
•1280 PL$="[RVSON] [c A][s I][s A] [s U][
 s I][s A][s A][c A][s C][c A][s I] "+R$+
```

```
"[RVSON] [c Q][s K][s B] [c Q][c W][s J]
[c W][c Q][s C][c Q][c J] "+R$+"[RVSON]
[s E] [c Z][s C][s E][s E] [s E][c Z][s
C][s E][s E] [UP][UP]"                     DN
·1290 ES$=SK$+"[c D][7"[c I]"][c F][DOWN]
[9"[LEFT]"][RVSON][c K][s Q][s S]CORE[s
Q][RVSOFF][c K][DOWN][9"[LEFT]"][c C][RV
SON][7"[c I]"][RVSOFF][c V][UP][UP]"+SK$
+"[DOWN][DOWN]"                            HC
·1298 :                                    DI
·1299 REM  PRINT TITLE                     AJ
·1300 PRINT"[CLEAR]":POKE 648,200:COL=0:F
OR I=12 TO 16:LN=I:GOSUB 50:PRINT"[RVSON
][YELLOW]" G$:NEXT                         OD
·1310 COL=4:LN=15:GOSUB 50:PRINT C1$:COL=
35:LN=13:GOSUB 50:PRINT C2$                JF
·1320 COL=10:LN=2:GOSUB 50:PRINT T0$:FORI
=1 TO 16:PRINTTAB(10)T1$ T$(I) T2$:NEXT    JN
·1330 PRINTTAB(10)T3$:PRINTTAB(10)T4$:POK
E 53272,44:POKE 56576,PEEK(56576)AND252    OD
·1340 POKE SC,15:POKE BO,15:GOSUB 1400     OG
·1350 PRINT SK$ "[s H]IT [RED][s I][c 4]
FOR [s I]NSTRUCTIONS, OR ANY ";            FO
·1360 PRINT SPC(12) "OTHER KEY TO SKIP TH
EM. ":GOSUB 20:IF I=73 THEN 200            AK
·1370 GOTO 400                             DI
·1398 :                                    DI
·1399 REM  PLAY THE MUSIC                  KB
·1400 RESTORE:GOSUB 60:POKE S+24,15        LO
·1410 POKE S+5,96:POKE S+6,70:POKES+12,96
:POKE S+13,70:POKE S+19,96:POKE S+20,70    HC
·1420 READ N1,N2,N3,DR:IF DR=-1 THEN GOSU
B 60:RETURN                                ML
·1430 H1=INT(N1/256):L1=N1-(H1*256):H2=IN
T(N2/256):L2=N2-(H2*256):H3=INT(N3/256)    DK
·1440 L3=N3-(H3*256):POKE S+1,H1:POKE S,L
1:POKE S+8,H2:POKE S+7,L2:POKE S+15,H3     OI
·1450 POKE S+14,L3:POKE S+4,17:POKE S+11,
17:POKE S+18,17:FOR T=1 TO DR*20:NEXT      LG
·1460 POKE S+4,16:POKE S+11,16:POKE S+18,
16:GOTO 1420                               JH
·1998 REM        DATA BLOC                 PL
·1999 REM  MUSIC                           GD
·2000 DATA 7217,8583,11457,6,7217,8583,11
457,2,7217,8583,11457,12                   IN
·2010 DATA 5728,7217,8583,12,8583,11457,1
4435,6,8583,11457,14435,2                  IM
·2020 DATA 8583,11457,14435,12,7217,8583,
11457,12,7217,8583,11457,6                 CF
·2030 DATA 8583,11457,14435,2,11457,14435
,17167,18,11457,14435,17167,4              FK
·2040 DATA 9634,12860,15294,4,9634,11457,
14435,4,8583,10814,12860,24                EP
·2050 DATA 8583,10814,12860,4,8583,11457,
14435,4,9634,12860,15294,12                PK
·2060 DATA 9634,12860,15294,12,8583,11457
,14435,6,8583,10814,12860,2                CI
·2070 DATA 8583,11457,14435,12,7217,8583,
11457,12,7217,8583,11457,4                 CD
·2080 DATA 8583,11457,14435,4,8583,10814,
12860,18,5728, 7217, 8583,4                KH
·2090 DATA 6430,7647,10814,4,8583,10814,1
2860,4,7217,8583,11457,24,0,0,0,-1         CN
·2098 :                                    DI
·2099 REM  CUSTOM TYPEFONT                 GO
·2100 DATA 169,0,133,251,133,253,169,216   EC
·2110 DATA 133,252,169,240,133,254,162     IF
·2120 DATA 16,160,0,177,251,145,253,136    IL
·2130 DATA 208,249,230,252,230,254,202     FP
·2140 DATA 208,240,96                      KA
·2198 :                                    DI
·2199 REM  SPRITES                         PL
·2200 DATA0,0,0,0,0,0,0,0,0,0,48,0,0,56,0
,0,56,0,0,124,0                            AF
·2210 DATA0,126,0,0,126,0,0,127,0,0,255,1
28,1,255,128,1,247,192,1,245,224           EF
·2220 DATA3,245,224,3,193,224,3,25,224,3,
131,224 ,3,199,192,1,231,128,0,248,0,0     NE
·2249 :                                    DI
·2250 DATA0,224,0,0,224,0,0,240,0,0,240,0
,1,240,0,3,248,0,3,216,0                   MI
·2260 DATA3,216,0,3,220,0,3,220,0,6,220,0
,14,222,0,14,214,0,12,199,0                FN
·2270 DATA28,87,128,24,85,128,26,7,128,14
,47,0,7,111,0,3,252,0,0,240,0,0            KK
·2299 :                                    DI
·2300 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0                                 DH
·2310 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,120,0                               EH
·2320 DATA0,252,0,1,254,0,1,255,0,3,255,0
,3,255,0,3,254,0,1,252,0,0                 IB
·2349 :                                    DI
·2350 DATA 0,12,0,0,30,0,0,30,0,0,30,0,0,
30,0,0,30,0,1,158,0,19,158,0,51,128,0      EE
·2360 DATA 115,159,192,112,31,192,7,193,1
92,127,159,192,127,191,192,63,255,128      OK
·2370 DATA 24,255,0,3,248,0,15,255,0,0,0,
0,7,254,0,7,254,0,0                        NO
·2399 :                                    DI
·2400 DATA0,0,0,0,0,0,0,0,0,63,227,224,80
,246,32,95,180,32,64,52,32,63,228,32       NN
·2410 DATA12,38,48,127,254,24,193,7,12,12
9,7,134,193,7,131,127,253,131,193,7,131    PK
·2420 DATA129,3,131,193,7,3,127,254,3,48,
70,3,48,67,3,31,254,3,0                    PN
·2449 :                                    DI
·2450 DATA7,255,254,7,255,254,6,127,254,4
,63,254,6,127,254,7,255,254,7,255,254      CN
·2460 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0       PD
·2470 DATA0,0,0,0,0,0,0,0                  FG
·2498 :                                    DI
·2499 REM JOYSTICK                         DA
·2500 DATA173,0,220,41,15,201,11,240,13,2
01,7,240,59,173,0,220,41,16,208,236        CH
```

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·2510 DATA96,0,173,6,208,205,1,192,240,22
6,205,3,192,208,24,169,0,141,21,208          BD
·2520 DATA141,16,208,173,4,192,141,6,208,
169,8,141,21,208,76,60,194,0,56,173          FI
·2530 DATA6,208,237,0,192,141,6,208,76,60
,194,0,173,6,208,205,2,192,240,176           CE
·2540 DATA205,4,192,208,25,169,0,141,21,2
08,169,8,141,16,208,173,3,192,141,6          CK
·2550 DATA208,169,8,141,21,208,76,60,194,
0,24,173,6,208,109,0,192,141,6,208           GO
·2560 DATA76,60,194,0,162,207,160,0,200,2
08,253,202,208,248,76,192,193                AN
·2598 :                                      DI
·2599 REM  CHARACTER DATA                    JB
·2600 DATA122,127,63,31,15,7,3,1,0           BK
·2610 DATA161,0,0,15,31,56,48,48,48          JI
·2620 DATA163,0,0,240,248,28,12,12,12        AN
·2630 DATA164,0,0,15,31,63,63,63,48          HF
·2640 DATA165,0,0,240,248,252,252,252,12     MK
·2650 DATA166,8,12,143,127,56,240,112,48     JJ
·2660 DATA167,16,48,241,254,28,15,14,12      LM
·2670 DATA168,0,0,15,30,62,62,54,50          HB
·2680 DATA169,0,0,240,120,124,124,108,76     OP
·2690 DATA170,48,48,56,31,15,0,0,0           PM
·2700 DATA171,12,12,28,248,248,0,0,0         MF
·2710 DATA193,255,255,255,195,195,195,195
,195                                         BI
·2720 DATA194,195,195,195,195,195,195,195
,195                                         CI
·2730 DATA195,255,255,255,7,7,255,255,255    GH
·2740 DATA196,255,255,255,224,224,255,255
,255                                         BG
·2750 DATA197,195,195,195,195,195,255,255
,255                                         KI
·2760 DATA201,255,255,255,15,7,131,195,19
5                                            JI
·2770 DATA202,195,195,193,224,240,255,255
,255                                         OH
·2780 DATA203,195,195,131,7,15,255,255,25
5                                            AA
·2790 DATA209,255,255,231,195,195,231,255
,255                                         HB
·2800 DATA213,255,255,255,240,224,193,195
,195                                         ND
·2810 DATA215,195,195,225,240,240,225,195
,195                                         CC
·2820 DATA235,195,195,195,192,192,195,195
,195                                         HE
·2830 DATA237,195,195,195,192,192,255,255
,255                                         BB
·2840 DATA238,255,255,255,3,3,195,195,195    KI
·2850 DATA240,255,255,255,192,192,195,195
,195                                         IF
·2860 DATA242,255,255,255,0,0,195,195,195    ID
·2870 DATA243,195,195,195,3,3,195,195,195    ML
·2880 DATA245,195,195,135,15,15,135,195,1
95                                           EA
·2890 DATA253,195,195,195,3,3,255,255,255    HD
·2900 DATA254,248,248,124,124,62,62,31,31    HN
·2910 DATA255,0,128,192,224,240,248,252,2
54,-1                                        KE
·2918 :                                      DI
·2919 REM  INTERRUPT REQUEST                 CN
·2920 DATA72,169,4,141,136,2,104,108,254,
207                                          CP
·4998 :                                      DI
·4999 REM  CHECK DATA                        HM
·5000 CK=0:CC=0                              AG
·5010 FOR I=1 TO 124:READ A:CK=CK+A:NEXT     DD
·5020 IF CK<>958347 THEN PRINT"ERROR IN M
USIC DATA, LINES 2[3"0"]-2090":STOP          GO
·5030 PRINT"MUSIC DATA OK":CK=0:CC=0         JJ
·5040 FOR I=1 TO 33:READ A:CK=CK+A:NEXT      NH
·5050 IF CK<>5974 THEN PRINT"ERROR IN FON
T DATA, LINES 2100-2140":STOP                IC
·5060 PRINT"FONT DATA OK":CK=0:CC=0          IN
·5070 CK(1)=4844:CK(2)=4520:CK(3)=1909:CK
(4)=4626:CK(5)=5185:CK(6)=3159               BA
·5080 FOR J=1 TO 6:FOR I=1 TO 64             GM
·5090 READ A:CK=CK+A:NEXT                    MI
·5100 IF CK<>CK(J) THEN PRINT"ERROR IN SP
RITE"J"DATA":STOP                            BA
·5110 PRINT"SPRITE#"J"DATA OK":CK=0:CC=0:
NEXT:CK=0:CC=0                               IJ
·5120 FOR J=1 TO 137:READ A:CK=CK+A:NEXT     EM
·5130 IF CK<>16579 THEN PRINT"ERROR IN JO
YSTICK DATA, LINES 2500-2560":STOP           KF
·5140 PRINT"JOYSTICK DATA OK":CK=0:CC=0      BK
·5150 FOR J=1 TO 289:READ A:CK=CK+A:NEXT     CG
·5160 IF CK<>44406 THEN PRINT"ERROR IN CH
ARACTER DATA, LINES 2600-2910":STOP          GM
·5170 PRINT"CHARACTER DATA OK":END           BF
·5180 FOR J=1 TO 10:READ A:CK=CK+A:NEXT      PH
·5190 IF CK<>1197 THEN PRINT"ERROR IN INT
ERRUPT DATA, LINE 2920":STOP                 DA
·5200 PRINT"INTERRUPT DATA OK":END           DP
```

STAR STRIKE
FROM PAGE 34

STAR STRIKE

```
·5 DN=PEEK(186)                              AG
·10 IFA=0THENA=1:LOAD"SPRITES",DN,1          PA
·15 SYS49152                                 KF
·20 IFA=1THENA=2:LOAD"SS",DN,1               BA
·30 POKE52,60:POKE56,60:CLR                  CF
·45 GOTO10100                                IJ
·50 POKE53281,6:POKE34058,0                  CB
·55 E=0:S=0:F=0:M=0:D$=""                    AN
·100 PRINT"[CLEAR][4"[DOWN]"]"TAB(5)"[RVS
```

```
ON][GREEN][27"*"]"                              EB
·105 PRINTTAB(5)"[RVSON]*[WHITE][7" "]SEL
ECT LEVEL[6" "][GREEN]*"                        NJ
·110 PRINTTAB(5)"[RVSON][27"*"]"                OP
·120 PRINT"[DOWN][DOWN][YELLOW]"TAB(13)"[
RVSON]1[RVSOFF]  BEGINNER"                      PH
·125 PRINT"[DOWN][DOWN][CYAN]"TAB(13)"[RV
SON]2[RVSOFF]  SKILLED"                         BO
·130 PRINT"[DOWN][DOWN][c 3]"TAB(13)"[RVS
ON]3[RVSOFF]  ADVANCED"                         HH
·135 PRINT"[DOWN][DOWN][c 6]"TAB(13)"[RVS
ON]4[RVSOFF]  NEUROTIC"                         EC
·140 TI$="[6"0"]":A$=""                         HA
·145 GETA$:IFVAL(A$)>0ANDVAL(A$)<5THEN160 MO
·150 IFVAL(TI$)>30THEN45                        HK
·155 GOTO145                                    CM
·160 IFVAL(A$)=1THENPOKE33083,50:POKE3438
1,1:POKE36539,40:A=50                           CP
·165 IFVAL(A$)=2THENPOKE33083,40:POKE3438
1,2:POKE36539,30:A=100                          JA
·170 IFVAL(A$)=3THENPOKE33083,25:POKE3438
1,3:POKE36539,20:A=150                          KH
·175 IFVAL(A$)=4THENPOKE33083,20:POKE3438
1,3:POKE36539,15:A=200                          FP
·180 PRINT"[CLEAR][5"[DOWN]"]"TAB(12)"[RV
SON][CYAN] STAR STRIKE "                        AO
·185 PRINTTAB(12)"[RVSON][3" "]PHASE I[3"
 "]"                                            MC
·190 GOSUB17000                                 IN
·200 FORX=37692TO37919:POKEX,0:NEXT             IK
·210 POKE37721,20:POKE37894,15:PRINT"[CLE
AR]"                                            HI
·220 GOSUB15000                                 JH
·230 SYS32768                                   KO
·240 FORX=1TO1000:NEXT                          OK
·250 POKE53269,0                                PL
·260 GOSUB16000                                 IK
·270 IFPEEK(37702)>0THEND$="1":GOSUB19000 MD
·280 E=PEEK(37719):F=PEEK(37913):S=PEEK(3
7721)                                           BO
·300 IFVAL(D$)=1THEN900                         DH
·420 PRINT"[CLEAR][5"[DOWN]"]"TAB(12)"[RV
SON][CYAN] STAR STRIKE "                        AO
·430 PRINTTAB(12)"[RVSON][3" "]PHASE II
"                                               MA
·440 GOSUB17000                                 IN
·450 FORX=37692TO37919:POKEX,0:NEXT             IK
·460 POKE37721,S:POKE37894,20:POKE37734,1
:PRINT"[CLEAR]"                                 BN
·470 GOSUB15000                                 JH
·480 SYS32768                                   KO
·490 FORX=1TO1000:NEXT                          OK
·500 POKE53269,0                                PL
·510 GOSUB16000                                 IK
·520 IFPEEK(37702)>0THEND$="1":GOSUB19000 MD
·530 E=E+PEEK(37719):F=F+PEEK(37913):S=PE
EK(37721)                                       LN
·670 IFVAL(D$)=1THEN900                         DH
·675 IFVAL(A$)=1THENPOKE34381,2                 JE
·676 IFVAL(A$)=2THENPOKE34381,3                 JG
·677 IFVAL(A$)=3THENPOKE34381,4:POKE34058
,1                                              MO
·678 IFVAL(A$)=4THENPOKE34381,5:POKE34058
,2                                              KP
·680 PRINT"[CLEAR][5"[DOWN]"]"TAB(12)"[RV
SON][CYAN] STAR STRIKE "                        AO
·690 PRINTTAB(12)"[RVSON]  PHASE [3"I"]
"                                               PI
·700 GOSUB17000                                 IN
·710 FORX=37692TO37919:POKEX,0:NEXT             IK
·720 POKE37725,1:POKE37721,S:PRINT"[CLEAR
]"                                              LA
·730 GOSUB15000                                 JH
·740 SYS32768                                   KO
·750 SYS36377                                   KI
·760 FORX=1TO1000:NEXT                          OK
·770 POKE53269,0                                PL
·780 POKE54276,0:POKE54290,0:POKE54283,0  PN
·790 GOSUB16000                                 IK
·800 IFPEEK(37910)=0THENGOSUB19000              JO
·805 IFPEEK(37910)>0THENGOSUB21000              MK
·900 POKE53281,6:POKE53280,2                    DD
·970 PRINT"[CLEAR][DOWN]"TAB(11)"[RVSON][
WHITE]  STAR STRIKE  "                          MD
·980 PRINTTAB(11)"[RVSON][4" "]SCORES[5"
"]"                                             BP
·1000 PRINT"[DOWN][DOWN][WHITE][3" "]ALIE
N SHIPS DESTROYED  [YELLOW][3"-"]",E            FN
·1010 PRINT"[DOWN][WHITE][4" "]ALIEN FIRE
 DESTROYED  [YELLOW][3"-"]",F                   PG
·1020 PRINT"[DOWN][WHITE] REMAINING SHIEL
D ENERGY  [YELLOW][3"-"]",S                     JD
·1050 T=E*A+S*A+F*A                             BL
·1060 PRINTTAB(12)"[DOWN][CYAN]TOTAL SCOR
E"                                              KL
·1065 PRINTTAB(15)"[DOWN][YELLOW]"T             DB
·1070 IFM=0THEN1110                             CA
·1075 T=T+1000                                  MI
·1080 PRINT"[WHITE][3"[DOWN]"]  BONUS FOR
  DESTROYING MOTHER SHIP"                       LE
·1090 PRINTTAB(12)"[YELLOW][DOWN]1[3"0"]
POINTS"                                         LK
·1100 PRINTTAB(5)"[WHITE][DOWN]GRAND TOTA
L  [YELLOW][4"-"]";T                            IJ
·1110 IFT>HSTHENHS=T                            ID
·1120 FORX=1TO10000:NEXT                        BO
·1130 GOTO45                                    PP
·10100 POKE53280,0:POKE53281,0:PRINT"[CLE
AR]"                                            AD
·10110 PRINT"[c 7][4" "][4"[c @]"][4" "][
6"[c @]"][16" "][3"[c @]"]"                     DD
·10120 PRINT"[3" "][s N][3" "][s N][s M]
 [s N][5" "][s N][s M][5" "][s N][s M][7
" "][s N]  [s N][s M]"                          EC
·10130 PRINT"  [RVSON][WHITE][sEP][4" "][
c *][RVSOFF][c 7][s N] [RVSON][WHITE][sE
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P][6" "][c *][RVSOFF][c 7][s N][4" "][RV
SON][WHITE][sEP][c *][RVSOFF][c 7] [s M]
[5" "][RVSON][WHITE][sEP][3" "][c *][RVS
OFF][c 7][s N][c G]"                       MN
•10140 PRINT"  [RVSON][WHITE]  [RVSOFF][c
 7][s N]  [s N][s M][4" "][RVSON][WHITE]
  [RVSOFF][c 7] [c G][5" "][RVSON][WHITE
][sEP]  [c *][RVSOFF][c 7] [s M][4" "][R
VSON][WHITE] [RVSOFF][sEP] [c *][RVSON]
[RVSOFF][c 7][s N]"                         FE
•10150 PRINT"  [WHITE][c *][RVSON][4" "][
c *][RVSOFF][c 7][s N][c G][3" "][RVSON]
[WHITE]  [RVSOFF][c 7] [c G][4" "][RVSON
][WHITE][sEP] [RVSOFF][sEP][c *][RVSON]
[c *][RVSOFF][c 7] [s M][3" "][RVSON][WH
ITE][4" "][RVSOFF][sEP][c 7][s M]"          MC
•10160 PRINT"  [s N]  [RVSON][WHITE][sEP]
  [RVSOFF][c 7][s N][4" "][RVSON][WHITE]
  [RVSOFF][c 7] [c G][3" "][RVSON][WHITE
][sEP][6" "][c *][RVSOFF][c 7] [s M]  [R
VSON][WHITE]  [RVSOFF][c *][RVSON] [c *]
[RVSOFF][c 7][s N][c G]"                    IN
•10170 PRINT"  [WHITE][c *][RVSON][4" "][
RVSOFF][sEP][5" "][RVSON]  [RVSOFF][c 7]
[s N][3" "][RVSON][WHITE][sEP] [RVSOFF][
sEP][4" "][c *][RVSON] [c *][RVSOFF][c 7
][s N]  [RVSON][WHITE]  [RVSOFF][c 7][s
N][RVSON][WHITE]  [RVSOFF][c 7][s N]"       MN
•10190 PRINT"[DOWN][3" "][c 7][4"[c @]"][
3" "][6"[c @]"]  [3"[c @]"][3" "][c @]
[c @][c @]  [c @]  [5"[c @]"]"              FH
•10200 PRINT"  [s N][3" "][s N][s M] [s N
][5" "][s N][c G][s N]  [s N][s M] [s N]
[s N][c G][s N] [s N][c G][s N][s N] [s
N][4" "][s N][c G]"                         IC
•10210 PRINT" [UP][WHITE][RVSON][sEP][4"
"][c *][c 7][RVSOFF][s N] [RVSON][WHITE]
[6" "][RVSOFF][c 7][s N][RVSON][WHITE][s
EP][3" "][c *][RVSOFF][c 7][s N][c G][RV
SON][WHITE] [RVSOFF][c 7] [c G][RVSON][W
HITE]  [RVSOFF][c 7] [RVSON][WHITE][sEP]
[RVSOFF][sEP]  [RVSON][5" "][RVSOFF][c 7
][s N]"                                     KE
•10220 PRINT" [RVSON][WHITE]  [RVSOFF][c
 7][s N]  [s N][s M][3" "][RVSON][WHITE]
 [RVSOFF] [c 7][c G] [RVSON][WHITE] [RVS
OFF][sEP] [c *][RVSON] [RVSOFF][c 7][s N
] [RVSON][WHITE] [RVSOFF] [c 7][c G][RVS
ON][WHITE]  [sEP][RVSOFF][sEP][c 7][c G]
  [RVSON][WHITE]  [RVSOFF] [c 7][s N][c
G]"                                         BB
•10230 PRINT" [WHITE][c *][RVSON][4" "][c
 *][RVSOFF][c 7][s N][c G]  [RVSON][WHIT
E]  [RVSOFF] [c 7][c G] [RVSON][WHITE][4
" "][RVSOFF][sEP][c 7][s M] [RVSON][WHIT
E] [RVSOFF][c 7] [c G][RVSON][WHITE][3"
"][RVSOFF][c 7][s N][s M]  [RVSON][WHITE
][3" "][RVSOFF][c 7][s N][c @][c @]"        MP
•10240 PRINT" [c 7][s N]  [RVSON][WHITE][
sEP]  [RVSOFF][c 7][s N][3" "][RVSON][WH
ITE]  [RVSOFF][c 7] [c G] [RVSON][WHITE]
  [RVSOFF]";                                IB
•10245 PRINT"[c *][RVSON] [c *][RVSOFF][c
 7][s N][c G][RVSON][WHITE] [RVSOFF] [c
7][c G][RVSON][WHITE]  [RVSOFF][c *][RVS
ON][c *][RVSOFF] [c 7][s M] [RVSON][WHIT
E]  [RVSOFF][c 7][s N][c T] [s N][c G]";    HB
•10250 PRINT"[DOWN][UP] [WHITE][c *][RVSO
N][4" "][RVSOFF][sEP][4" "][RVSON]  [RVS
OFF][c 7][s N]  [RVSON][WHITE]  [RVSOFF]
[c 7][s N]";                                KA
•10255 PRINT"[RVSON][WHITE]  [RVSOFF][c 7
][s N] [RVSON][WHITE] [RVSOFF][c 7][s N]
 [RVSON][WHITE]  [RVSOFF][c 7][s N][WHIT
E][c *][RVSON][c *][RVSOFF][c 7][s N] [R
VSON][WHITE][5" "][RVSOFF][c 7][s N]"       CA
•10260 PRINT"[DOWN]"TAB(19)"[YELLOW]BY":P
RINTTAB(16)"BOB EATON"                      ED
•10265 PRINTTAB(12)"[DOWN][WHITE]HI SCORE
[3" "]";HS                                  JO
•10270 PRINT"[DOWN][YELLOW][3" "]PRESS A
KEY OR FIRE TO CONTINUE[HOME]"              HF
•10280 POKE198,0:SYS35478                   IM
•10300 GOTO50                               PD
•15000 POKE56578,PEEK(56578)OR3             BN
•15010 POKE56576,(PEEK(56576)AND252)OR2     KG
•15020 POKE53272,PEEK(53272)OR8             ME
•15030 POKE53265,PEEK(53265)OR32            AL
•15040 RETURN                               IM
•16000 POKE56578,PEEK(56578)OR3             BN
•16010 POKE56576,(PEEK(56576)AND252)OR3     KF
•16020 POKE53272,21:POKE53265,27            ID
•16030 RETURN                               IM
•17000 POKE53281,6:PRINT"[3"[DOWN]"]"TAB(
12)"[WHITE] GET READY ! "                   GC
•17010 PRINT"[3"[DOWN]"]"TAB(8)"[YELLOW]P
RESS FIRE TO CONTINUE                       EF
•17020 POKE198,0:SYS35478                   IM
•17030 RETURN                               IM
•19000 POKE53281,0:PRINT"[CLEAR][10"[DOWN
]"][YELLOW]"TAB(6)"YOU HAVE BEEN DESTROY
ED[3"!"]"                                   HM
•19010 FORX=1TO4000:NEXT                    NP
•19020 RETURN                               IM
•21000 POKE53281,6:POKE53280,2              DD
•21010 PRINT"[CLEAR][WHITE][6"[DOWN]"]"TA
B(10)"CONGRATULATIONS[3"!"]"                DO
•21030 PRINT"[5"[DOWN]"]"TAB(5)"YOU HAVE
COMPLETED YOUR MISSION.":M=1                FP
•21040 FORX=1TO5000:NEXT                    AG
•21050 RETURN                               IM
```

Beginning address in hex: C000
Ending address in hex: C43C

SPRITES

```
C000: A9 00 85 FB 8D 00 CA 8D 11
C008: 01 CA A8 A9 57 85 FC A9 A9
C010: 00 91 FB C8 C0 00 D0 F7 EF
C018: E6 FC A5 FC C9 61 D0 EF 8A
C020: A9 85 85 FB A9 A5 85 FD A3
C028: A9 00 85 A5 A9 C0 85 FC E9
C030: A9 C1 85 FE A9 57 85 A6 4D
C038: A0 00 A2 00 B1 FB 8D 02 B8
C040: CA 29 80 F0 03 20 7A C0 04
C048: E6 A5 D0 02 E6 A6 E0 07 1D
C050: F0 0A 0E 02 CA E8 AD 02 BE
C058: CA 4C 41 C0 E6 FB D0 02 27
C060: E6 FC AD 01 CA F0 07 AD 63
C068: 00 CA C9 1F F0 0B EE 00 07
C070: CA D0 C7 EE 01 CA 4C 3A 15
C078: C0 60 B1 FD 91 A5 E6 FD 65
C080: D0 02 E6 FE 60 24 92 5B AB
C088: 7F FF FF FE D2 01 24 92 91
C090: 40 70 12 49 24 00 2F FF EF
C098: 49 2F FF B4 00 00 00 BF 85
C0A0: 49 24 BF 00 00 00 00 02 CF
C0A8: 49 24 80 00 00 00 00 00 96
C0B0: 09 24 00 00 00 00 00 00 DD
C0B8: 01 20 00 00 00 00 00 00 D9
C0C0: 01 20 00 00 00 00 00 00 E1
C0C8: 00 20 00 00 00 00 00 00 E8
C0D0: 09 20 00 00 01 00 00 00 FA
C0D8: 0B A0 00 00 01 00 00 00 85
C0E0: 5F F4 00 00 01 00 00 00 36
C0E8: FF FE 00 00 01 00 00 00 E8
C0F0: 01 00 00 00 01 00 00 00 F2
C0F8: 01 20 00 00 01 00 04 10 2F
C100: 41 20 00 00 01 01 00 82 E5
C108: 49 24 00 00 01 08 20 90 2F
C110: 49 24 92 40 00 49 04 92 30
C118: 49 24 D3 FF B4 49 24 92 0E
C120: 4D 3D FF FF F4 00 00 00 9F
C128: 49 36 80 00 01 00 00 86 AF
C130: DB FF F6 C0 01 01 01 FF C6
C138: FF FF FF CA 81 F3 7F FF F7
C140: FF FF FF EF AF F3 FF ED C1
C148: B6 DB 6F FF EF E8 C8 4C 38
C150: 13 80 E8 93 C7 40 C0 0C 35
C158: 00 00 28 00 57 20 00 40 38
C160: 00 00 00 80 09 92 49 36 FB
C168: DF FF FF FE D8 00 01 FF 21
C170: E3 FF C0 00 01 00 00 00 16
C178: 1C 00 00 00 01 00 00 00 95
C180: 1C 20 00 00 01 00 00 00 BD
C188: 1C 00 00 00 01 49 24 92 A5
C190: 4B 6D B6 DB 2D 49 24 92 09
C198: 49 24 92 49 25 49 24 92 07
C1A0: 49 6C 96 DB 6D 02 02 02 3C
C1A8: 02 02 02 05 82 16 86 5A 2D
C1B0: 86 01 6A 06 05 A8 16 16 82
C1B8: A5 5A 16 95 6A 55 55 6B E4
C1C0: 7D AA AF 7D AA AF 7D AA 98
C1C8: AF 55 55 6B 55 0A 14 0A 0C
C1D0: 02 10 10 10 10 10 10 10 43
C1D8: FF 01 FF 10 10 10 10 10 2A
C1E0: 10 10 18 07 99 E0 07 66 08
C1E8: E0 03 A5 C0 01 E7 80 FF 9C
C1F0: 66 42 C3 01 66 80 02 FF 47
C1F8: 40 05 C3 A0 07 81 E0 07 13
C200: E0 06 60 18 01 99 80 01 7B
C208: E7 80 FF 3C 66 66 3C DB 91
C210: 01 C3 80 01 81 80 18 5A CA
C218: 3C 18 18 24 42 24 18 18 3F
C220: 24 18 18 18 18 10 04 16 CE
C228: 04 7F 14 01 56 80 14 7F 2B
C230: 56 05 55 A0 0F FF F0 05 86
C238: 55 A0 56 7F 01 55 80 15 EF
C240: 55 68 3F FF FC 15 55 68 0D
C248: 01 55 80 7F 18 FF 18 18 E6
C250: FF 08 04 08 1C 1C FF 04 A0
C258: 0A 14 02 1C 3E 3E 1C FF 2D
C260: 08 10 04 10 04 01 24 01 B6
C268: 3E 7F 7F 7F 3E 02 08 04 71
C270: 08 02 08 02 14 20 04 49 06
C278: 02 80 80 3E FF 80 01 FF 3B
C280: C0 01 FF C0 01 FF C0 FF C4
C288: 80 3E 08 20 02 08 02 20 9B
C290: 14 08 22 90 80 04 81 40 A5
C298: 02 7F 05 FF D0 03 FF E0 D3
C2A0: 03 FF E0 03 FF E0 03 FF 6B
C2A8: E0 03 FF E0 01 FF C0 7F AE
C2B0: 5E 2A 55 5C 80 76 80 3D 9F
C2B8: FC 10 01 F1 02 9F 03 FD 5B
C2C0: 02 F6 80 07 BC 80 14 EA 7D
C2C8: 90 04 FF 80 03 6C 01 80 CE
C2D0: 04 04 FF 10 02 FE C0 09 B3
C2D8: 09 20 03 FB E0 03 9F 20 A4
C2E0: 07 FF 20 03 F7 E0 07 BE A9
C2E8: B0 9C EF D4 04 FF F0 03 F2
C2F0: 6C D8 05 94 D8 0D 95 FE 4A
C2F8: 11 40 FF 01 10 20 20 08 A3
C300: 9C 01 BF A0 12 E9 B8 03 B5
C308: FB E0 2F 1F 60 0B FB F5 90
C310: 0B 8B 78 3F 45 2A 37 51 56
C318: F0 0D 84 B0 9E 51 B4 1D 0D
C320: 85 F0 1F 6C B8 05 B7 F9 91
C328: 8F DE B4 FF E0 11 C6 C4 C8
C330: FC 42 08 44 FF 01 10 20 EC
C338: 20 28 9C 02 01 A2 21 12 F5
C340: 49 38 43 1B E0 2E 20 2A 79
C348: 14 0A 18 BA 0A 34 10 10 97
C350: 31 10 34 10 30 50 18 04 72
C358: 01 D9 AA 02 B4 01 FC 60 F2
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C360: 11 C6 C4 04 FC 02 28 40 68
C368: FF 04 06 10 40 09 20 80 6C
C370: 01 09 20 40 80 04 01 80 E0
C378: 01 20 10 04 20 08 44 12 2C
C380: 20 21 18 FF 41 08 80 08 AB
C388: 80 20 01 20 01 44 10 FF 9F
C390: 01 01 80 80 FF 80 80 80 15
C398: 80 80 80 82 50 92 94 92 A6
C3A0: A5 90 A9 40 94 2A 50 A5 75
C3A8: 5A 94 A9 56 94 E9 55 55 C0
C3B0: FA AA 7D FA AA 7D FA AA 9C
C3B8: 7D E9 55 55 A0 55 A0 14 75
C3C0: 80 1F FF F8 3F FF FC 7F 15
C3C8: FF FE FF FF FF FF FF FF C7
C3D0: 7F EF FE 3F FF FC 1F FF 9A
C3D8: F8 AA 92 49 24 09 49 24 F2
C3E0: 92 10 55 24 92 49 FE 10 E7
C3E8: 10 10 10 28 48 88 88 88 23
C3F0: 90 01 10 02 08 04 04 04 A8
C3F8: 02 04 02 02 04 01 08 01 11
C400: 08 01 04 82 01 01 01 10 A2
C408: 10 30 48 84 42 22 14 08 95
C410: 10 20 50 48 24 42 84 48 0C
C418: 84 88 50 28 55 10 10 30 43
C420: 48 48 28 18 14 22 42 84 ED
C428: 01 08 01 10 90 88 01 04 60
C430: 02 02 04 01 04 02 02 02 43
C438: 01 01 F6 FF 00 31
```

Beginning address in hex: 8000
Ending address in hex: 9216

SS

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8000: A9 2F 8D 18 D4 A9 01 8D 8B
8008: 76 93 8D 7F 93 8D 77 93 4B
8010: 8D 83 93 A9 64 8D 72 93 56
8018: 8D 74 93 8D 7E 93 A9 C8 BF
8020: 8D 81 93 A9 00 8D 10 D0 DA
8028: 8D 17 D0 A9 12 8D 08 D4 C3
8030: A9 FA 8D 0D D4 8D 14 D4 BA
8038: 8D 06 D4 A9 F2 8D 17 D4 B6
8040: A9 AC 8D 04 D0 A9 B8 8D E8
8048: 02 D0 A9 88 8D 00 D0 A9 55
8050: 80 8D 05 D0 A9 E6 8D 01 53
8058: D0 8D 03 D0 A9 03 8D 1D E1
8060: D0 AD 1C D0 09 C3 8D 1C 42
8068: D0 A9 07 8D 27 D0 8D 28 25
8070: D0 8D 29 D0 8D 2D D0 8D E1
8078: 2E D0 A9 06 8D 25 D0 A9 54
8080: 00 8D 26 D0 A9 01 8D 2A 67
8088: D0 A9 08 8D 2B D0 8D 2C 4E
8090: D0 A9 5D 8D FA 47 A9 5C 3E
8098: 8D F8 47 A9 78 8D F9 47 57
80A0: 37 35 35 38 30 39 38 3A 56
80A8: 20 38 44 20 46 38 20 34 38
80B0: 37 20 41 39 20 37 38 20 32
80B8: 38 44 20 46 39 20 34 37 60
80C0: 20 38 30 39 38 3A 20 38 4D
80C8: 44 20 46 38 20 34 37 20 57
80D0: 41 39 20 37 38 20 38 44 77
80D8: 20 46 39 20 34 37 34 37 6F
80E0: 37 34 34 38 30 39 38 3A 94
80E8: 20 38 44 20 46 38 20 34 78
80F0: 37 20 41 39 20 37 38 20 72
80F8: 38 44 20 46 39 20 38 30 9D
8100: 39 38 3A 20 38 44 20 46 AE
8108: 38 20 34 37 20 41 39 20 86
8110: 37 38 20 38 44 20 46 39 BB
8118: 46 39 39 46 46 38 30 39 FE
8120: 38 3A 20 38 44 20 46 38 CD
8128: 20 34 37 20 41 39 20 37 A5
8130: 38 20 38 44 20 38 30 39 C6
8138: 38 3A 20 38 44 20 46 38 E5
8140: 20 34 37 20 41 39 20 37 BD
8148: 38 20 38 44 38 44 44 38 16
8150: 38 38 30 39 38 3A 20 38 F4
8158: 44 20 46 38 20 34 37 20 E6
8160: 41 39 20 37 38 20 38 30 F2
8168: 39 38 3A 20 38 44 20 46 17
8170: 38 20 34 37 20 41 39 20 EE
8178: 37 38 37 38 38 37 37 38 36
8180: 30 39 38 3A 20 38 44 20 19
8188: 46 38 20 34 37 20 41 39 2D
8190: 20 38 30 39 38 3A 20 38 1D
8198: 44 20 46 38 20 34 37 20 27
81A0: 41 39 41 39 39 41 41 38 89
81A8: 30 39 38 3A 20 38 44 20 41
81B0: 46 38 20 34 37 20 38 30 43
81B8: 39 38 3A 20 38 44 20 46 67
81C0: 38 20 34 37 34 37 37 34 5B
81C8: 34 38 30 39 38 3A 20 38 69
81D0: 44 20 46 38 20 38 30 39 75
81D8: 38 3A 20 38 44 20 46 38 86
81E0: 46 38 38 46 46 38 30 39 C5
81E8: 38 3A 20 38 44 20 38 30 80
81F0: 39 38 3A 20 38 44 38 44 B5
81F8: 44 38 38 38 30 39 38 3A C1
8200: 20 38 30 39 38 38 38 30 9A
8208: 39 39 38 30 30 38 38 38 BB
8210: 30 39 30 3A 20 44 30 20 98
8218: 41 39 20 35 44 20 38 44 C8
8220: 20 46 41 20 34 37 20 41 B4
8228: 39 20 35 43 20 33 45 33 C5
8230: 45 45 33 33 38 30 39 30 F2
8238: 3A 20 44 30 20 41 39 20 C1
8240: 35 44 20 38 44 20 46 41 FD
8248: 20 34 37 20 41 39 20 35 C3
8250: 43 20 38 30 39 30 3A 20 DF
8258: 44 30 20 41 39 20 35 44 01
8260: 20 38 44 20 46 41 20 34 F8
8268: 37 20 41 39 20 35 43 35 08
8270: 43 43 35 35 38 30 39 30 33
8278: 3A 20 44 30 20 41 39 20 02
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8280: 35 44 20 38 44 20 46 41 3E
8288: 20 34 37 20 41 39 20 38 07
8290: 30 39 30 3A 20 44 30 20 19
8298: 41 39 20 35 44 20 38 44 49
82A0: 20 46 41 20 34 37 20 41 35
82A8: 39 41 39 39 41 41 38 30 80
82B0: 39 30 3A 20 44 30 20 41 4A
82B8: 39 20 35 44 20 38 44 20 48
82C0: 46 41 20 34 37 20 38 30 5C
82C8: 39 30 3A 20 44 30 20 41 62
82D0: 39 20 35 44 20 38 44 20 60
82D8: 46 41 20 34 37 34 37 37 8E
82E0: 34 34 38 30 39 30 3A 20 75
82E8: 44 30 20 41 39 20 35 44 91
82F0: 20 38 44 20 46 41 20 38 8D
82F8: 30 39 30 3A 20 44 30 20 81
8300: 41 39 20 35 44 20 38 44 B0
8308: 20 46 41 46 41 41 46 46 05
8310: 38 30 39 30 3A 20 44 30 B0
8318: 20 41 39 20 35 44 20 38 A4
8320: 44 20 38 30 39 30 3A 20 B0
8328: 44 30 20 41 39 20 35 44 D0
8330: 20 38 44 38 44 44 38 38 FD
8338: 38 30 39 30 3A 20 44 30 D8
8340: 20 41 39 20 35 44 20 38 CC
8348: 30 39 30 3A 20 44 30 20 D0
8350: 41 39 20 35 44 35 44 44 22
8358: 35 35 38 30 39 30 3A 20 EE
8360: 44 30 20 41 39 20 38 30 F7
8368: 39 30 3A 20 44 30 20 41 02
8370: 39 41 39 39 41 41 38 30 48
8378: 39 30 3A 20 44 33 37 38 23
8380: 3A 20 33 39 20 33 30 20 EA
8388: 33 41 20 32 30 20 34 34 08
8390: 34 34 34 34 34 38 33 37 38
8398: 38 3A 20 33 39 20 33 30 1B
83A0: 20 33 41 20 32 30 20 38 10
83A8: 33 37 38 3A 20 33 39 20 32
83B0: 33 30 20 33 41 20 32 30 2B
83B8: 32 30 30 32 32 38 33 37 52
83C0: 38 3A 20 33 39 20 33 30 43
83C8: 20 33 41 20 38 33 37 38 58
83D0: 3A 20 33 39 20 33 30 20 3B
83D8: 33 41 33 41 41 33 33 38 A1
83E0: 33 37 38 3A 20 33 39 20 6A
83E8: 33 30 20 38 33 37 38 3A 81
83F0: 20 33 39 20 33 30 33 30 64
83F8: 30 33 33 38 33 37 38 3A A4
8400: 20 33 39 20 38 33 37 38 87
8408: 3A 20 33 39 33 39 39 33 A7
8410: 33 38 33 37 38 3A 20 38 B0
8418: 33 37 38 38 38 33 37 37 CC
8420: 38 33 33 38 38 38 33 37 D1
8428: 30 3A 20 33 39 20 34 31 A4
8430: 20 33 39 20 33 39 20 34 9D
8438: 31 20 34 31 20 33 38 20 9A
8440: 33 30 20 34 38 34 38 38 D4
8448: 34 34 38 33 37 30 3A 20 DD
8450: 33 39 20 34 31 20 33 39 CE
8458: 20 33 39 20 34 31 20 34 BE
8460: 31 20 33 38 20 33 30 20 C0
8468: 38 33 37 30 3A 20 33 39 02
8470: 20 34 31 20 33 39 20 33 D5
8478: 39 20 34 31 20 34 31 20 DC
8480: 33 38 20 33 30 33 30 30 03
8488: 33 33 38 33 37 30 3A 20 1C
8490: 33 39 20 34 31 20 33 39 0F
8498: 20 33 39 20 34 31 20 34 FE
84A0: 31 20 33 38 20 38 33 37 20
84A8: 30 3A 20 33 39 20 34 31 25
84B0: 20 33 39 20 33 39 20 34 1E
84B8: 31 20 34 31 20 33 38 33 2E
84C0: 38 38 33 33 38 33 37 30 6A
84C8: 3A 20 33 39 20 34 31 20 35
84D0: 33 39 20 33 39 20 34 31 4F
84D8: 20 34 31 20 38 33 37 30 51
84E0: 3A 20 33 39 20 34 31 20 4D
84E8: 33 39 20 33 39 20 34 31 67
84F0: 20 34 31 34 31 31 34 34 75
84F8: 38 33 37 30 3A 20 33 39 92
8500: 20 34 31 20 33 39 20 33 65
8508: 39 20 34 31 20 38 33 37 89
8510: 30 3A 20 33 39 20 34 31 8C
8518: 20 33 39 20 33 39 20 34 85
8520: 31 34 31 31 34 34 38 33 BB
8528: 37 30 3A 20 33 39 20 34 AA
8530: 31 20 33 39 20 33 39 20 9A
8538: 38 33 37 30 3A 20 33 39 D1
8540: 20 34 31 20 33 39 20 33 A5
8548: 39 33 39 39 33 33 38 33 F8
8550: 37 30 3A 20 33 39 20 34 D2
8558: 31 20 33 39 20 38 33 37 D8
8560: 30 3A 20 33 39 20 34 31 DC
8568: 20 33 39 33 39 39 33 33 01
8570: 38 33 37 30 3A 20 33 39 0A
8578: 20 34 31 20 38 33 37 30 F0
8580: 3A 20 33 39 20 34 31 34 01
8588: 31 31 34 34 38 33 37 30 26
8590: 3A 20 33 39 20 38 33 37 1A
8598: 30 3A 20 33 39 33 39 39 35
85A0: 33 33 38 33 37 30 3A 20 34
85A8: 38 33 37 30 30 38 33 37 4E
85B0: 37 38 33 33 38 38 38 33 62
85B8: 36 38 3A 20 33 39 20 33 41
85C0: 30 20 33 41 20 32 30 20 28
85C8: 34 34 20 33 30 20 32 30 37
85D0: 20 34 31 20 30 32 30 32 3B
85D8: 32 30 30 38 33 36 38 3A 7F
85E0: 20 33 39 20 33 30 20 33 44
85E8: 41 20 32 30 20 34 34 20 55
85F0: 33 30 20 32 30 20 34 31 5C
85F8: 20 38 33 36 38 3A 20 33 80
8600: 39 20 33 30 20 33 41 20 71
8608: 32 30 20 34 34 20 33 30 76
8610: 20 32 30 20 34 31 34 31 7D
8618: 31 34 34 38 33 36 38 3A C5
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8620: 20 33 39 20 33 30 20 33 83
8628: 41 20 32 30 20 34 34 20 94
8630: 33 30 20 32 30 20 38 33 A1
8638: 36 38 3A 20 33 39 20 33 C0
8640: 30 20 33 41 20 32 30 20 A7
8648: 34 34 20 33 30 20 32 30 B6
8650: 32 30 30 32 32 38 33 36 E8
8658: 38 38 45 45 38 36 35 30 27
8660: 3A 20 33 32 20 33 30 20 C3
8668: 33 30 20 33 32 20 33 32 D6
8670: 20 33 38 20 33 33 20 33 D5
8678: 36 20 38 36 35 30 3A 20 FC
8680: 33 32 20 33 30 20 33 30 EC
8688: 20 33 32 20 33 32 20 33 E6
8690: 38 20 33 33 20 33 36 33 0C
8698: 36 36 33 33 38 36 35 30 3F
86A0: 3A 20 33 32 20 33 30 20 04
86A8: 33 30 20 33 32 20 33 32 17
86B0: 20 33 38 20 33 33 20 38 1B
86B8: 36 35 30 3A 20 33 32 20 34
86C0: 33 30 20 33 30 20 33 32 2D
86C8: 20 33 32 20 33 38 20 33 2D
86D0: 33 33 33 33 33 33 38 36 72
86D8: 35 30 3A 20 33 32 20 33 51
86E0: 30 20 33 30 20 33 32 20 3A
86E8: 33 32 20 33 38 20 38 36 68
86F0: 35 30 3A 20 33 32 20 33 69
86F8: 30 20 33 30 20 33 32 20 52
8700: 33 32 20 33 38 33 38 38 94
8708: 33 33 38 36 35 30 3A 20 9C
8710: 33 32 20 33 30 20 33 30 7C
8718: 20 33 32 20 33 32 20 38 7B
8720: 36 35 30 3A 20 33 32 20 9B
8728: 33 30 20 33 30 20 33 32 94
8730: 20 33 32 33 32 32 33 33 B3
8738: 38 36 35 30 3A 20 33 32 CB
8740: 20 33 30 20 33 30 20 33 9A
8748: 32 20 38 36 35 30 3A 20 C8
8750: 33 32 20 33 30 20 33 30 BC
8758: 20 33 32 33 32 32 33 33 DB
8760: 38 36 35 30 3A 20 33 32 F3
8768: 20 33 30 20 33 30 20 38 C7
8770: 36 35 30 3A 20 33 32 20 EB
8778: 33 30 20 33 30 33 30 30 F2
8780: 33 33 38 36 35 30 3A 20 15
8788: 33 32 20 33 30 20 38 36 FF
8790: 35 30 3A 20 33 32 20 33 09
8798: 30 33 30 30 33 33 38 36 31
87A0: 35 30 3A 20 33 32 20 38 1E
87A8: 36 35 30 3A 20 33 32 33 37
87B0: 32 32 33 33 38 36 35 30 4F
87B8: 3A 20 38 36 35 30 30 38 4F
87C0: 36 35 35 38 36 36 38 38 76
87C8: 38 36 34 38 3A 20 33 34 65
87D0: 20 33 34 20 32 30 20 33 2E
87D8: 33 20 33 30 20 32 30 20 32
87E0: 33 32 20 33 30 20 42 36 62
87E8: 42 36 36 42 42 38 36 34 BE
87F0: 38 3A 20 33 34 20 33 34 72
87F8: 20 32 30 20 33 33 20 33 55
8800: 30 20 32 30 20 33 32 20 58
8808: 33 30 20 38 36 34 38 3A A0
8810: 20 33 34 20 33 34 20 32 71
8818: 30 20 33 33 20 33 30 20 72
8820: 32 30 20 33 32 20 33 30 8B
8828: 33 30 30 33 33 38 36 34 C4
8830: 38 3A 20 33 34 20 33 34 B1
8838: 20 32 30 20 33 33 20 33 94
8840: 30 20 32 30 20 33 32 20 98
8848: 38 36 34 38 3A 20 33 34 E4
8850: 20 33 34 20 32 30 20 33 AD
8858: 33 20 33 30 20 32 30 20 B1
8860: 33 32 33 32 32 33 33 38 FB
8868: 36 34 38 3A 20 33 34 20 EC
8870: 33 34 20 32 30 20 33 33 E0
8878: 20 33 30 20 32 30 20 38 D6
8880: 36 34 38 3A 20 33 34 20 05
8888: 33 34 20 32 30 20 33 33 F8
8890: 20 33 30 20 32 30 32 30 F8
8898: 30 32 32 38 36 34 38 3A 42
88A0: 20 33 34 20 33 34 20 32 02
88A8: 30 20 33 33 20 33 30 20 03
88B0: 38 36 34 38 3A 20 33 34 4D
88B8: 20 33 34 20 32 30 20 33 16
88C0: 33 20 33 30 33 30 30 33 3E
88C8: 33 38 36 34 38 3A 20 33 64
88D0: 34 20 33 34 20 32 30 20 2F
88D8: 33 33 20 38 36 34 38 3A 74
88E0: 20 33 34 20 33 34 20 32 42
88E8: 30 20 33 33 33 33 33 33 6C
88F0: 33 38 36 34 38 3A 20 33 8C
88F8: 34 20 33 34 20 32 30 20 57
8900: 38 36 34 38 3A 20 33 34 9C
8908: 20 33 34 20 32 30 32 30 74
8910: 30 32 32 38 36 34 38 3A B9
8918: 20 33 34 20 33 34 20 38 7F
8920: 36 34 38 3A 20 33 34 20 A4
8928: 33 34 33 34 34 33 33 38 C9
8930: 36 34 38 3A 20 3A 20 33 BA
8938: 36 20 33 34 20 33 38 20 A1
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8988: 39 33 30 3A 20 33 36 20 09
8990: 33 34 20 33 38 20 38 39 15
8998: 33 30 3A 20 33 36 20 33 13
89A0: 34 20 33 38 33 38 38 33 37
89A8: 33 38 39 33 30 3A 20 33 3E
89B0: 36 20 33 34 20 38 39 33 33
89B8: 30 3A 20 33 36 20 33 34 34
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89E8: 33 33 38 39 39 38 38 38 A2
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89F8: 33 34 20 33 33 20 33 34 6E
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8A08: 33 20 33 38 20 43 39 43 A6
8A10: 39 39 43 43 38 39 32 38 E4
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8A20: 33 33 20 33 34 20 33 34 95
8A28: 20 33 33 20 33 33 20 33 88
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8A40: 20 33 34 20 33 34 20 33 A2
8A48: 33 20 33 33 20 33 38 33 C0
8A50: 38 38 33 33 38 39 32 38 03
8A58: 3A 20 33 33 20 33 34 20 C0
8A60: 33 33 20 33 34 20 33 34 D5
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8A70: 39 32 38 3A 20 33 33 20 F4
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8BC0: 39 39 39 31 45 30 3A 20 6D
8BC8: 33 41 20 32 30 20 33 33 46
8BD0: 20 33 33 20 32 30 20 33 2D
8BD8: 39 20 33 31 20 34 33 20 3E
8BE0: 36 46 36 46 46 36 36 39 C5
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8D28: 42 45 38 3A 20 33 31 20 C6
8D30: 34 35 20 33 30 20 33 41 B1
8D38: 20 32 30 20 33 33 20 34 95
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8D48: 38 3A 20 33 31 20 34 35 C8
8D50: 20 33 30 20 33 41 20 32 BA
8D58: 30 20 33 33 20 34 31 20 B4
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8DD8: 38 3A 20 33 31 20 34 35 59
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8DE8: 30 20 38 42 45 38 3A 20 8B
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8DF8: 20 33 41 20 32 30 32 30 72
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8E08: 20 33 31 20 34 35 20 33 69
8E10: 30 20 33 41 20 38 42 45 B4
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8E20: 20 33 30 20 33 41 33 41 AC
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8E30: 20 33 31 20 34 35 20 33 91
8E38: 30 20 38 42 45 38 3A 20 DA
8E40: 33 31 20 34 35 20 33 30 B1
8E48: 33 30 30 33 33 38 42 45 02
8E50: 38 3A 20 33 31 20 34 35 D0
8E58: 20 38 42 45 38 3A 20 33 FD
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8E68: 34 38 42 45 38 3A 20 33 22
8E70: 31 20 38 42 45 38 3A 20 14
8E78: 33 31 33 31 31 33 33 38 11
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8EC8: 36 20 34 36 20 33 36 20 33
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8ED8: 38 45 44 30 3A 20 33 33 8B
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8EE8: 33 20 38 45 44 30 3A 20 88
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8EF8: 20 33 33 33 33 33 33 33 7F
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8F28: 33 33 20 33 36 20 38 45 B5
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8F38: 36 33 36 36 33 33 38 45 F1
8F40: 44 30 3A 20 33 33 20 38 CD
8F48: 45 44 30 3A 20 33 33 33 F5
8F50: 33 33 33 33 38 45 44 30 0F
8F58: 3A 20 38 45 44 30 30 38 0D
8F60: 45 44 44 38 45 45 38 38 61
8F68: 38 45 43 38 3A 20 33 36 25
8F70: 20 32 30 20 33 34 20 33 CD
8F78: 36 20 32 30 20 33 33 20 D7
8F80: 33 36 20 32 30 20 33 33 F2
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8F90: 38 3A 20 33 36 20 32 30 0F
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8FA8: 32 30 20 38 45 43 38 3A 5E
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8FB8: 34 20 33 36 20 32 30 20 19
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8FD8: 20 33 34 20 33 36 20 32 3C
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8FE8: 38 45 43 38 3A 20 33 36 A5
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8FF8: 36 20 32 30 20 33 33 20 58
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9058: 20 32 30 20 33 34 20 33 B5
9060: 36 20 32 30 32 30 30 32 DD
9068: 32 38 45 43 38 3A 20 33 21
9070: 36 20 32 30 20 33 34 20 D0
9078: 33 36 20 38 45 43 38 3A 35
9080: 20 33 36 20 32 30 20 33 DF
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9090: 33 38 45 43 38 3A 20 33 4A
9098: 36 20 32 30 20 33 34 20 F8
90A0: 38 45 43 38 3A 20 33 36 5D
90A8: 20 32 30 20 33 34 33 34 1A
90B0: 34 33 33 38 45 43 38 3A 7E
90B8: 20 33 36 20 32 30 20 38 1D
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90C8: 32 30 32 30 30 32 32 38 5A
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90D8: 38 45 43 38 3A 20 33 36 95
90E0: 33 36 36 33 33 38 45 43 A7
90E8: 38 3A 20 38 45 43 38 38 AC
90F0: 38 45 43 43 38 45 45 38 EF
90F8: 38 38 45 43 30 3A 20 32 AE
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9100: 30 20 33 34 20 33 36 20 61
9108: 32 30 20 33 33 20 33 36 7A
9110: 20 32 30 20 33 34 20 32 6C
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9128: 34 20 33 36 20 32 30 20 88
9130: 33 33 20 33 36 20 32 30 A2
9138: 20 33 34 20 38 45 43 30 D0
9140: 3A 20 32 30 20 33 34 20 A4
9148: 33 36 20 32 30 20 33 33 BA
9150: 20 33 36 20 32 30 20 33 AF
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9188: 32 30 20 33 33 20 33 36 FA
9190: 20 32 30 32 30 30 32 32 0A
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91A8: 30 20 33 33 20 33 36 20 09
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91B8: 33 33 34 34 39 31 42 30 64
91C0: 3A 20 33 38 20 34 35 20 30
91C8: 39 31 42 30 3A 20 33 38 6B
91D0: 20 34 35 34 35 35 34 34 61
91D8: 39 31 42 30 3A 20 33 38 7B
91E0: 20 39 31 42 30 3A 20 33 6B
91E8: 38 33 38 38 33 33 39 31 95
91F0: 42 30 3A 20 39 31 42 30 9A
91F8: 30 39 31 42 42 39 31 31 B3
9200: 39 39 39 31 41 38 3A 20 B0
9208: 33 30 20 32 30 20 33 33 74
9210: 20 33 33 20 32 30 20 39
```

LAZYBASIC

FROM PAGE 26

Beginning address in hex: C000
Ending address in hex: C6C6
SYS to start: 49152
***Flankspeed* required for entry! See page 85.**

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C000: 78 A9 3F 8D 14 03 A9 C0 70
C008: 8D 15 03 A9 21 8D 02 03 0B
C010: A9 C0 8D 03 03 58 60 20 E6
C018: 9F FF 4C 02 C1 18 4C 31 5D
C020: EA A9 CE 85 5F A9 C3 85 5B
C028: 60 A9 C6 85 5A A9 C6 85 CE
C030: 5B A9 F8 85 58 A9 06 85 41
C038: 59 20 BF A3 4C 83 A4 A5 2F
C040: C5 C9 40 D0 06 8D EA C2 22
C048: 4C AF C0 CD EA C2 F0 5F D0
C050: 8D EA C2 A2 03 DD EB C2 BD
C058: F0 05 CA 10 F8 30 50 8A 2D
C060: AE 8D 02 E0 01 D0 10 C9 2B
C068: 03 F0 3B C9 02 F0 34 C9 52
C070: 01 F0 2A C9 00 F0 29 C9 3A
C078: 03 F0 0C C9 02 F0 1B C9 1A
C080: 01 F0 14 C9 00 F0 0D A9 F7
C088: 7B 8D 23 C1 A9 11 8D 1C DA
C090: C1 4C 02 C1 4C 88 C1 4C 45
C098: 95 C1 4C 9C C1 4C B7 C1 60
C0A0: 4C A3 C1 4C CB C1 4C D8 51
C0A8: C1 20 9F FF 4C 02 C1 4C 86
C0B0: 31 EA 38 E9 7F AA A0 FF B9
C0B8: CA F0 08 C8 B9 9E A0 10 4E
C0C0: FA 30 F5 C8 B9 9E A0 30 D3
C0C8: 05 20 D6 C0 D0 F5 29 7F F4
C0D0: 20 EF C0 4C 31 EA E0 00 EA
C0D8: D0 0A A2 20 8E 77 02 A2 21
C0E0: 14 8E 78 02 8D 79 02 EE F5
C0E8: E5 C0 EE EE C0 60 02 20 B0
C0F0: E4 C0 A9 79 8D E5 C0 AD 9B
C0F8: EE C0 85 C6 A9 02 8D EE 1D
C100: C0 60 A5 C5 C9 40 D0 06 6D
C108: 8D EA C2 4C 2B C1 CD EA 35
C110: C2 F0 18 8D EA C2 A2 12 CB
C118: DD F8 C2 F0 11 CA 10 F8 87
C120: 30 5F BD 7B C3 4C B2 C0 6C
C128: 4C 31 EA 4C A9 C0 E0 07 2F
C130: 10 03 4C 22 C1 E0 10 F0 55
C138: 08 A9 20 8D 77 02 4C 6D CA
C140: C1 A9 83 A0 C3 20 1E AB 7D
C148: A9 00 85 C6 A9 31 8D 14 BA
C150: 03 A9 EA 8D 15 03 A9 83 BA
C158: 8D 02 03 A9 A4 8D 03 03 CC
C160: A9 57 8D 24 03 A9 F1 8D 3F
C168: 25 03 4C 31 EA A9 14 8D 44
C170: 78 02 EE E5 C0 EE EE C0 1F
C178: BD E8 C2 20 EF C0 4C 31 30
C180: EA A9 00 85 C6 4C 9F C2 10
C188: A9 48 8D 23 C1 A9 05 8D 29
C190: 1C C1 4C 02 C1 A9 59 8D 0F
C198: 23 C1 10 F1 A9 6A 8D 23 44
C1A0: C1 10 EA AD 21 D0 18 69 7E
C1A8: 01 C9 10 F0 06 8D 21 D0 F9
C1B0: 4C 31 EA A9 00 90 F6 AD F7
C1B8: 20 D0 18 69 01 C9 10 F0 F6
C1C0: 06 8D 20 D0 4C 31 EA A9 57
C1C8: 00 90 F6 A9 1C 20 FC C1 F4
C1D0: 8D 3F C3 A2 FF 6C 00 03 73
C1D8: A9 08 20 FC C1 8D 43 C3 FD
C1E0: 8D 3D C3 A5 15 8D 42 C3 BD
C1E8: 8D 3C C3 A9 1F 8D 24 03 F3
C1F0: A9 C2 8D 25 03 A9 00 8D 4A
C1F8: 45 C3 10 D7 A0 C3 20 1E 8C
C200: AB 20 60 A5 86 7A 84 7B D2
C208: 20 73 00 AA F0 F3 A2 FF CD
C210: 86 3A 90 01 18 20 6B A9 AF
C218: A9 00 85 C6 A5 14 60 20 48
C220: 57 F1 08 85 FB C9 0D F0 BA
C228: 04 A5 FB 28 60 E6 C8 A5 AB
C230: C8 CD 45 C3 F0 04 30 02 F6
C238: 10 0C A9 57 8D 24 03 A9 B3
C240: F1 8D 25 03 B0 E3 A9 0D 33
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C248: 20 D2 FF A5 D6 8D 3B C3 44
C250: CE 3B C3 86 FC 84 FD AD D1
C258: 42 C3 AE 43 C3 85 62 86 82
C260: 63 8E 3D C3 8D 3C C3 A2 83
C268: 90 38 20 49 BC 20 DD BD 13
C270: A2 00 BD 01 01 F0 07 9D 68
C278: 77 02 E8 4C 72 C2 E8 86 CB
C280: C6 8E 45 C3 AD 43 C3 18 AB
C288: 6D 3F C3 8D 43 C3 90 03 21
C290: EE 42 C3 A6 FC A4 FD AD 79
C298: 3B C3 85 D6 4C 29 C2 AD D9
C2A0: AD C3 C9 99 D0 06 20 BF 2C
C2A8: C2 4C AF C2 20 D4 C2 A2 84
C2B0: 00 BD AD C3 E8 9D D0 06 3D
C2B8: E0 20 D0 F5 4C 31 EA A2 8B
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C2C8: C3 A9 1E 9D F8 06 E8 E0 BA
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C2D8: C3 18 69 80 9D AD C3 A9 57
C2E0: 20 9D F8 06 E8 E0 20 D0 58
C2E8: ED 60 3E 04 05 06 03 25 AC
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C420: 2D 01 0E 04 20 20 20 20 E0
C428: 07 0F 14 0F 20 20 20 82 44
C430: 20 12 05 01 04 20 20 20 CC
C438: 20 20 20 20 14 01 0E 20 FB
C440: 20 20 2D 2D 82 20 83 2D 2E
C448: 2D 01 13 03 20 20 20 20 0D
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C458: 20 12 05 0D 20 20 20 20 1D
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C4C8: 0C 05 0E 20 20 20 20 86 EE
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C620: 20 20 2D 2D 8E 20 8F 2D 26
C628: 2D 06 0F 12 20 20 20 20 FC
C630: 10 05 05 0B 20 20 20 8F 45
C638: 20 13 14 0F 10 20 20 20 FE
C640: 20 20 20 20 1B 20 20 20 3C
C648: 20 20 2D 2D 8F 20 90 2D 50
C650: 2D 06 12 05 20 20 20 20 1B
C658: 10 0F 0B 05 20 20 20 90 78
C660: 20 13 14 12 24 20 20 20 3E
C668: 20 20 20 20 1D 20 20 20 66
C670: 20 20 2D 2D 90 20 91 2D 7A
C678: 2D 07 05 14 20 20 20 20 46
C680: 10 0F 13 20 20 20 20 91 C4
C688: 20 13 19 13 20 20 20 20 68
C690: 20 20 20 A0 84 89 85 A1 C6
C698: A1 20 2D 2D 91 20 20 20 A6
C6A0: 20 86 B1 20 20 20 20 20 99
C6A8: 86 B3 20 20 20 20 20 20 A3
C6B0: 20 86 B5 20 20 20 20 20 AD
C6B8: 20 20 20 20 86 B7 20 20 B7
C6C0: 20 20 20 20 20 20 FF 81
```

QUEEN'S AND BISHOP'S TOURS
FROM PAGE 41

```
·10 REM - QUEEN'S & BISHOP'S TOURS                JB
·20 REM - FOR THE COMMODORE 128                   BD
·30 REM - DANIEL MILLER                           DK
·40 REM - 2815 34 STREET                          OA
·50 REM - ASTORIA, NEW YORK   11103               NM
·60 REM - 12/28/85                                GG
·70 GOTO890                                       DF
·80 SPRITE CH,1,1,0,0,0,0:MOVSPR CH,40,14
0                                                 LP
·90 CHAR 1,5,22,"[BLACK]PLACE ":IF CH=1 T
HEN PRINT"QUEEN";:ELSE PRINT"BISHOP";             FA
·100 PRINT" AT (ROW,[RVSON]COL[RVSOFF]):[
4" "][3"[LEFT]"]";                                GF
·110 GETKEY R$                                    BH
·120 FOR X=1 TO 8:IF R$<>MID$("12345678",
X,1) THEN NEXT:GOTO110:ELSE PRINT R$;:R1
=VAL(R$)                                          MO
·130 GETKEY C1$                                   DI
·140 FOR X=1 TO 8:IF C1$<>MID$("ABCDEFGH"
,X,1) THEN NEXT:GOTO130:ELSE PRINT C1$:C
1=ASC(C1$)-64                                     DO
·150 IF CH=1 THEN170:ELSE RC=(R1-1)*8+C1:
IF MID$(B$,RC,1)="1" THEN170:ELSE MSG$="
INVALID LOCATION"                                 DF
·160 CHAR 1,12,24,MSG$:SLEEP3:CHAR 1,12,2
4,"[19" "]":GOTO90                                FG
·170 DX=DX+(C1-1)*24:DY=DY+(R1-1)*16:MOVS
PR CH,DX,DY                                       CJ
·180 CHAR 1,5,22,"[30" "]":DT=0:RETURN            JB
·190 PRINT"[CLEAR]":PRINTTAB(12)"[RVSON][
BLACK]"HDG$(CH)"[RVSOFF]":COLOR0,16               BF
·200 PRINT"[HOME][4"[DOWN]"]" TAB(9)"[BLA
CK][RVSON]A[RVSOFF]  [RVSON]B[RVSOFF]  [
RVSON]C[RVSOFF]  [RVSON]D[RVSOFF]  [RVSO
N]E[RVSOFF]  [RVSON]F[RVSOFF]  [RVSON]G[
RVSOFF]  [RVSON]H[RVSOFF]"                        CH
·210 PRINTTAB(6)"[BLACK]1 ";:R=1:GOSUB290         PE
·220 PRINTTAB(6)"[BLACK]2 ";:R=2:GOSUB290         OG
·230 PRINTTAB(6)"[BLACK]3 ";:R=3:GOSUB290
:CHAR 1,34,9,"[BLACK]MOVE":PRINT"[DOWN]"          ID
·240 PRINTTAB(6)"[BLACK]4 ";:R=4:GOSUB290         MO
·250 PRINTTAB(6)"[BLACK]5 ";:R=5:GOSUB290         PE
·260 PRINTTAB(6)"[BLACK]6 ";:R=6:GOSUB290         OG
·270 PRINTTAB(6)"[BLACK]7 ";:R=7:GOSUB290         BM
·280 PRINTTAB(6)"[BLACK]8 ";:R=8:GOSUB290
:IF DT=0 THEN300:ELSE GOSUB80:GOTO300             IL
·290 FOR C=1 TO 8:PRINTA$(RC(R,C));U$;:NE
XT:PRINT"[DOWN]":RETURN                           AO
·300 IF F1=0 THEN IF (CH=1 AND SLV=192) O
R (CH=2 AND SLV=158) THEN730:ELSE IF (CH
=1 AND SLV=192) OR (CH=2 AND SLV=158) TH
EN YN$="N":GOTO790                                HC
·310 FR$=STR$(R1)+C1$:FR=(R1*10)+(ASC(C1$
)-64):C1=ASC(C1$)-64                              PO
·320 CHAR 1,12,22,"[BLACK]FROM: ":CHAR 1,
17,22,FR$                                         DL
·330 CHAR 1,24,22,"TO:[3" "][4"[LEFT]"]"          HL
·340 IF F1=1 THEN READ TU$:R2=VAL(LEFT$(T
U$,1)):C2$=RIGHT$(TU$,1):C2=ASC(C2$)-64:
CHAR 1,28,22,TU$:GOTO400                          IJ
·350 GETKEY R2$                                   EG
·360 IF R2$=CHR$(133) THEN MSG$="[BLACK]C
OMPUTER SOLUTION (Y/N): ":GOTO760                 PE
·370 FOR X=1 TO 8:IF R2$<>MID$("12345678"
,X,1) THEN NEXT X:R2$="":GOTO350:ELSE R2
=VAL(R2$):CHAR 1,28,22,R2$                        FL
·380 GETKEY C2$                                   DP
·390 FOR X=1 TO 8:IF C2$<>MID$("ABCDEFGH"
,X,1) THEN NEXT X:C2$="":GOTO380:ELSE CH
AR 1,29,22,C2$:C2=ASC(C2$)-64                     OB
·400 TU=(R2*10)+C2:IF CH=1 THEN410:ELSE I
F RC(R2,C2)<>3 THEN410:ELSE MSG$="SPACE
OCCUPIED":GOTO730                                 IJ
·410 FT=ABS(FR-TU):ON CH GOTO420,440              EB
·420 IF FT=9 OR FT=11 OR FT<=7 OR FT<=77
THEN430:ELSE MSG$="INVALID MOVE":GOTO730          BF
·430 IF FT<=7 THEN XY=FT:GOTO460:ELSE IF
FT/10=INT(FT/10) THEN XY=INT(FT/10):GOTO
460                                               EA
```

```
•440 IF (FT/11<>INT(FT/11)) AND (FT/9<>IN
T(FT/9)) THEN MSG$="INVALID MOVE":GOTO73
0                                         ON
•450 IF FT/9=INT(FT/9) THEN XY=FT/9:GOTO4
60:ELSE XY=FT/11                          OC
•460 RO=R1:CO=C1                          MD
•470 IF R1>R2 THEN IF C1>C2 THEN X1=1:Y1=
-1:XZ=1:GOTO550                           II
•480 IF R1>R2 THEN IF C1<C2 THEN X1=-1:Y1
=-1:XZ=2:GOTO550                          FL
•490 IF R1<R2 THEN IF C1<C2 THEN X1=-1:Y1
=1:XZ=3:GOTO550                           BA
•500 IF R1<R2 THEN IF C1>C2 THEN X1=1:Y1=
1:XZ=4:GOTO550                            JK
•510 IF R1=R2 THEN IF C1<C2 THEN X1=-1:Y1
=0:XZ=5:GOTO550                           DM
•520 IF R1<R2 THEN IF C1=C2 THEN X1=0:Y1=
1:XZ=6:GOTO550                            KE
•530 IF R1>R2 THEN IF C1=C2 THEN X1=0:Y1=
-1:XZ=7:GOTO550                           HC
•540 IF R1=R2 THEN IF C1>C2 THEN X1=1:Y1=
0:XZ=8                                    OG
•550 L=0:LL=1:LP=1:DO UNTIL LP>XY         KH
•560 MOVSPR CH,DX-24*X1,DY+16*Y1          IE
•570 DX=DX-24*X1:DY=DY+16*Y1              FE
•580 RC(RO,CO)=3                          CH
•590 ON XZ GOTO600,610,620,630,640,650,66
0,670                                     BH
•600 RO=RO-1:CO=CO-1:GOTO680              FE
•610 RO=RO-1:CO=CO+1:GOTO680              EP
•620 RO=RO+1:CO=CO+1:GOTO680              FC
•630 RO=RO+1:CO=CO-1:GOTO680              GP
•640 CO=CO+1:GOTO680                      AH
•650 RO=RO+1:GOTO680                      EF
•660 RO=RO-1:GOTO680                      BC
•670 CO=CO-1                              MP
•680 LP=LP+1:LOOP                         AF
•690 MV=MV+1:MV$=STR$(MV):CHAR 1,33,11,MV
$                                         JO
•700 SLV=0:FOR R=1 TO 8:FOR C=1 TO 8:SLV=
SLV+RC(R,C):NEXTC,R:IF (CH=1 AND SLV=192
) OR (CH=2 AND SLV=158) THEN MSG$="[c 3]
CONGRATULATIONS!!"                        OJ
•710 R1=R2:C1$=C2$:FR$="":TU$="":CT=FRE(0
):GOTO200                                 BL
•720 REM - MESSAGE RTN.                   OP
•730 T=(20-LEN(MSG$)/2):FORX=1TO5:CHAR 1,
T,24,MSG$,1:SLEEP1:CHAR 1,T,24,MSG$,0:SL
EEP1:NEXT                                 CB
•740 CHAR 1,T,24,"[17" "]":IF (CH=1 AND S
LV=192) OR (CH=2 AND SLV=158) THEN YN$="
N":GOTO790:ELSE GOTO200                   KL
•750 REM - COMPUTER SOLUTION              NO
•760 F1=1:T=(20-LEN(MSG$)/2):CHAR 1,T,24,
MSG$                                      IA
•770 GETKEY YN$                           HB
•780 IF YN$<>"Y" AND YN$<>"N" THEN770:ELS
E CHAR 1,T,24,"[25" "]"                   KG
•790 IF YN$="Y" THEN830:ELSE MSG$="[BLACK
]TRY AGAIN (Y/N): ":KEY1,"GRAPHIC"        KL
•800 T=(20-LEN(MSG$)/2):CHAR 1,T,24,MSG$  NI
•810 GETKEY YN$                           HB
•820 IF YN$<>"Y" AND YN$<>"N" THEN810:ELS
E IF YN$="Y" THEN SPRITE CH,0:RUN:ELSE C
HAR 1,11,24," [BLACK]THANKS FOR PLAYING"
:SLEEP 3:SPRITE CH,0:PRINT"[CLEAR]":END   DF
•830 MV=0:CHAR 1,33,11,"[4" "]":ON CH GOT
O850,870:REM - AUTOSOLVE MODE             FJ
•840 REM - QUEEN'S TOUR                   BI
•850 RESTORE1190:DX=88:DY=89:R1=1:C1$="A"
:GOTO1080                                 NH
•860 REM - BISHOP'S TOUR                  GD
•870 RESTORE1220:DX=256:DY=201:R1=8:C1$="
H":GOTO1080                               MH
•880 REM - INTRO & INIT                   KL
•890 DIM A$(3),HDG$(2),RC(8,8)            NN
•900 PRINT"[CLEAR]"TAB(8)"[WHITE]CHESSBOA
RD TOURS - C128":PRINT:PRINT"  LEAD THE
QUEEN OR THE BISHOP ON A TOUR":PRINT" OF
 THE CHESSBOARD."                         PN
•910 PRINT:PRINT"  THE QUEEN MAY MOVE PAR
ALLEL TO THE":PRINT" SIDES OF THE BOARD
OR DIAGONALLY FOR":PRINT" ANY NUMBER OF
SQUARES.  THE QUEEN MUST  FINISH ON";     PP
•920 PRINT" THE SAME SQUARE ON WHICH SHE"
:PRINT" STARTED.  VISIT ALL THE SQUARES
IN":PRINT" 14 MOVES.":PRINT               EO
•930 PRINT"  THE BISHOP MUST VISIT ALL TH
E WHITE":PRINT" SQUARES IN 17 MOVES.  TH
E BISHOP MOVES"                           EL
•940 PRINT" DIAGONALLY AND MAY BEGIN AND
END ON":PRINT" DIFFERENT SQUARES."        KM
•950 PRINT:PRINT"  PRESS 'F1' TO END EITH
ER PUZZLE.":PRINT" YOU MAY ALSO SEE THE
COMPUTER SOLVE":PRINT" THE PUZZLES."      NF
•960 CHAR 1,7,24,"PRESS <RETURN> TO CONTI
NUE"                                      KD
•970 GETKEY RT$                           GE
•980 IF RT$<>CHR$(13) THEN RT$="":GOTO970 BM
•990 PRINT"[CLEAR]"TAB(12)"[WHITE]CHESSBO
ARD TOURS":CHAR 1,10,7,"1. QUEEN'S TOUR"
:CHAR 1,10,8,"2. BISHOP'S TOUR":CHAR 1,1
0,9,"3. END PROGRAM"                      HP
•1000 CHAR 1,14,12,"ENTER CHOICE: "       EE
•1010 GETKEY CH$                          FB
•1020 IF CH$<"1" OR CH$>"3" THEN CH$="":G
OTO1010:ELSE CH=VAL(CH$):IF CH=3 THEN KE
Y1,"GRAPHIC":END                          BN
•1030 CHAR 1,28,12,CH$                    AG
•1040 A$(1)="[RVSON][WHITE][3" "][DOWN][3
"[LEFT]"][3" "][RVSOFF]":A$(2)="[RVSON][
RED][3" "][DOWN][3"[LEFT]"][3" "][RVSOFF
]":A$(3)="[RVSON][BLUE][3"[c +]"][DOWN][
3"[LEFT]"][3"[c +]"][RVSOFF]"             JH
•1050 IF CH=1 THEN A$(3)="[RVSON][YELLOW]
[3" "][DOWN][3"[LEFT]"][3" "][RVSOFF]"    LC
```

```
•1060 U$="[UP]":F1=0                              KG
•1070 HDG$(1)=" THE QUEEN'S TOUR ":HDG$(2
)="THE BISHOP'S TOUR"                             ON
•1080 B$="1212121221212121121212122121212
1121212122121212112121212212121 21"               BO
•1090 X=1:FOR R=1 TO 8:FOR C=1 TO 8:RC(R,
C)=VAL(MID$(B$,X,1)):X=X+1:NEXTC,R                EN
•1100 IF F1=1 THEN MOVSPR CH,DX,DY:GOTO20
0                                                 GA
•1110 IF CH=1 THEN RESTORE1180:ELSE RESTO
RE1210                                            IP
•1120 FOR X=(3584+((CH-1)*64)) TO (3646+(
(CH-1)*64)):READ DT:POKE X,DT:NEXT                IP
•1130 DT=1:DX=89:DY=89                            IJ
•1140 KEY1,CHR$(133):REM - 'F1'                   LD
•1150 GOTO190                                     CK
•1160 REM - SPRITE DATA & SOLUTIONS               PP
•1170 REM - QUEEN                                 DH
•1180 DATA ,,,,,,,,,,,,,32,,128,112,8,80,
248,80,43,254,160,21,37,64,10,170,128,7,
255,,,112,,,112,,,112,,1,252,,7,255,,,,,
,,,,,,,,,,,,255                                   BF
•1190 DATA 1H,8H,2B,2H,8B,4B,8F,8C,4G,8G,
3B,3F,8A,1A                                       LK
•1200 REM - BISHOP                                IA
•1210 DATA ,,,,,,,32,,,32,,1,252,,,32,,,3
2,,2,34,,1,36,,,168,,,112,,,112,,,112,,,
112,,1,252,,7,255,,,,,,,,,,,,,,,,0                PO
•1220 DATA 4D,7A,8B,2H,1G,3E,6H,8F,3A,1C,
2D,1E,4H,8D,5A,3C,1A                              AC
```

SHAKER

FROM PAGE 45

Starting address in hex: C000
Ending address in hex: C878
SYS to start: 49152

```
C000: 4C 77 C7 A9 00 8D 20 D0 B3
C008: 8D 21 D0 8D 15 D0 8D 10 98
C010: D0 AA BD EE C0 20 D2 FF EB
C018: E8 E0 2E D0 F5 A0 00 8C 04
C020: 3C 03 8C 3D 03 8C 3E 03 F9
C028: A2 03 8E 40 03 A0 01 B9 FA
C030: CE 04 09 80 20 4A C1 AD 66
C038: 00 DC 29 0F 49 0F 85 FB 27
C040: B9 CE 04 29 7F 99 CE 04 E1
C048: A5 FB 29 04 F0 07 88 C0 58
C050: 00 D0 02 A0 05 A5 FB 29 93
C058: 08 F0 07 C8 C0 06 D0 02 BA
C060: A0 01 84 FC A2 07 A0 07 D4
C068: 18 20 F0 FF A4 FC B9 1B 08
C070: C1 4A 4A 4A 4A 18 69 30 0D
C078: 20 D2 FF B9 1B C1 29 0F 3A
C080: 18 69 30 20 D2 FF B9 20 FE
C088: C1 4A 4A 4A 4A 18 69 30 25
C090: 20 D2 FF B9 20 C1 29 0F 57
C098: 18 69 30 20 D2 FF AD 00 EA
C0A0: DC 29 10 D0 8A 8C 3F 03 E0
C0A8: B9 1B C1 8D 43 03 B9 20 EC
C0B0: C1 8D 42 03 A2 00 BD 26 CB
C0B8: C1 20 D2 FF E8 E0 23 D0 2B
C0C0: F5 AD 3F 03 4A 4A 4A 4A CF
C0C8: 18 69 30 20 D2 FF AD 3F 5A
C0D0: 03 29 0F 18 69 30 20 D2 B0
C0D8: FF A9 0A 85 FB A2 00 A0 51
C0E0: 00 88 D0 FD CA D0 FA C6 95
C0E8: FB A5 FB D0 F0 60 93 05 41
C0F0: 53 48 41 4B 45 52 11 11 D2
C0F8: 42 59 20 4A 4F 48 4E 20 05
C100: 46 45 44 4F 52 0D 11 11 A0
C108: 4C 45 56 45 4C 3A 20 31 0D
C110: 32 33 34 35 0D 11 42 4F 8E
C118: 4E 55 53 3A 00 02 05 07 57
C120: 10 00 60 20 80 90 93 0D 62
C128: 0D 0D 0D 0D 0D 0D 0D 0D 90
C130: 0D 0D 0D 20 20 20 20 20 F7
C138: 20 20 20 20 20 20 20 20 39
C140: 20 20 20 4C 45 56 45 4C 1A
C148: 3A 20 99 CE 04 84 FC A0 31
C150: 40 A2 00 CA D0 FD 88 D0 26
C158: FA A4 FC 60 AD 3F 03 4A 8F
C160: 4A 4A 4A 0A 85 FB 0A 0A DE
C168: 18 65 FB 85 FB AD 3F 03 53
C170: 29 0F 18 65 FB AA E0 0B B8
C178: 90 02 A2 0B A9 BF 38 E9 44
C180: 10 CA D0 FA 8D 41 03 60 59
C188: A0 0A AE 41 03 CA D0 FD BF
C190: 88 D0 F7 60 78 A2 00 A9 07
C198: 32 9D 00 D0 18 69 1E E8 C1
C1A0: E8 E0 0E D0 F4 A2 00 A9 8A
C1A8: 8B 9D 01 D0 E8 E8 E0 0E 64
C1B0: D0 F7 58 A9 7F 8D 15 D0 6E
C1B8: 8D 1C D0 A9 00 8D 10 D0 4B
C1C0: 8D 17 D0 8D 1D D0 AA A9 06
C1C8: FF 9D F8 07 A9 02 9D 27 D6
C1D0: D0 E8 E0 08 D0 F1 A9 01 E0
C1D8: 8D 25 D0 60 A2 00 8A 9D 87
C1E0: 44 03 E8 E0 08 D0 F8 60 24
C1E8: A2 00 8A 9D 00 D4 E8 E0 52
C1F0: 18 D0 F8 A9 0F 8D 18 D4 06
C1F8: 60 AD 04 DC 85 8B 6D 05 6B
C200: DC 85 8C 6D 06 DC 85 8D 52
C208: 6D 07 DC 85 8E 66 8C 66 C6
C210: 8E 26 8D 26 8B 26 8E 66 1F
C218: 8D 26 8C 66 8B 66 8D EA 29
C220: A2 00 B5 8B C9 07 90 08 6D
C228: E8 E0 05 D0 F5 4C F9 C1 C5
C230: AA 60 A2 00 BD DD C2 20 5C
C238: D2 FF E8 E0 16 D0 F5 20 D1
C240: DC C1 20 94 C1 A0 00 84 7A
C248: FB 20 F9 C1 BD 44 03 D0 F5
C250: F8 A9 01 9D 44 03 A9 F8 7B
C258: 8D 06 D4 A9 4C 8D 01 D4 1A
C260: 86 FC A2 00 A0 00 88 D0 80
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C268: FD CA D0 FA A9 81 8D 04 B9
C270: D4 A2 01 86 FD A2 01 86 97
C278: FE A5 FC 0A AA FE 01 D0 9F
C280: 20 D2 C2 A6 FE E8 E0 0A AF
C288: D0 ED A2 01 86 FE A5 FC 13
C290: 0A AA DE 01 D0 20 D2 C2 AB
C298: A6 FE E8 E0 13 D0 ED A2 7C
C2A0: 01 86 FE A5 FC 0A AA FE 7D
C2A8: 01 D0 20 D2 C2 A6 FE E8 BE
C2B0: E0 0A D0 ED A6 FC A9 FF A7
C2B8: 9D F8 07 A6 FD E8 E0 03 C7
C2C0: D0 B1 A9 80 8D 04 D4 A4 78
C2C8: FB C8 C0 06 F0 03 4C 47 DB
C2D0: C2 60 A0 0A A2 00 CA D0 DC
C2D8: FD 88 D0 FA 60 93 05 53 77
C2E0: 48 41 4B 49 4E 47 20 53 08
C2E8: 49 58 20 43 41 4E 53 2E FE
C2F0: 20 20 0D 93 05 4D 49 58 C5
C2F8: 49 4E 47 20 54 48 45 20 F9
C300: 43 41 4E 53 2E 0D A2 00 04
C308: BD F3 C2 20 D2 FF E8 E0 39
C310: 13 D0 F5 A2 01 86 FB 20 30
C318: 94 C1 20 F9 C1 86 FC 20 ED
C320: F9 C1 86 FD A5 FC C5 FD C6
C328: B0 ED A6 FC BD 44 03 A8 18
C330: A6 FD BD 44 03 A6 FC 9D 1B
C338: 44 03 A6 FD 98 9D 44 03 A1
C340: A0 1A A5 FC 0A AA FE 01 52
C348: D0 A5 FD 0A AA DE 01 D0 22
C350: 88 84 02 20 88 C1 A4 02 70
C358: D0 E8 38 A5 FD E5 FC 85 56
C360: FE A0 1D 18 65 FE 88 D0 F2
C368: FA 85 FE A8 A5 FC 0A AA E7
C370: FE 00 D0 A5 FD 0A AA DE 77
C378: 00 D0 88 84 02 20 88 C1 C2
C380: A4 02 D0 E8 A0 1A A5 FC 3E
C388: 0A AA DE 01 D0 A5 FD 0A 9B
C390: AA FE 01 D0 88 84 02 20 3B
C398: 88 C1 A4 02 D0 E8 A6 FB E5
C3A0: E8 E0 10 F0 03 4C 15 C3 93
C3A8: 60 AA AA AA 80 00 02 80 0C
C3B0: 00 02 80 00 02 80 00 02 B7
C3B8: 80 00 02 80 00 02 80 00 3E
C3C0: 02 80 00 02 80 00 02 80 48
C3C8: 00 02 80 00 02 80 00 02 CF
C3D0: 80 00 02 80 00 02 80 00 56
C3D8: 02 80 00 02 80 00 02 80 60
C3E0: 00 02 80 00 02 AA AA AA 65
C3E8: FF 00 00 00 2A AA A8 2A 90
C3F0: 56 A8 2A 69 A8 2A 56 A8 55
C3F8: 2A 6A A8 2A 6A A8 2A AA 48
C400: A8 2A 55 A8 2A 69 A8 2A 37
C408: 69 A8 2A 69 A8 2A 55 A8 7E
C410: 2A AA A8 2A 56 A8 2A 69 4A
C418: A8 2A 56 A8 2A 6A A8 2A 51
C420: 6A A8 2A AA A8 00 00 00 B0
C428: A2 00 BD A9 C3 9D 80 3F 53
C430: E8 E0 80 D0 F5 60 93 05 3A
C438: 43 48 4F 4F 53 45 20 54 6F
C440: 48 45 20 43 4F 52 52 45 6A
C448: 43 54 20 43 41 4E 2E 0D 0E
C450: A2 00 BD 36 C4 20 D2 FF 9E
C458: E8 E0 1A D0 F5 20 94 C1 79
C460: A0 00 A9 FE 99 F8 07 AD F0
C468: 00 DC 29 0F 49 0F 85 FB 57
C470: 84 FC 20 81 C6 A4 FC A9 A5
C478: FF 20 24 C6 A5 FB 29 04 52
C480: F0 11 88 A9 21 8D 04 D4 3C
C488: A9 20 8D 04 D4 C0 FF D0 4A
C490: 02 A0 06 A5 FB 29 08 F0 FC
C498: 11 C8 A9 21 8D 04 D4 A9 4D
C4A0: 20 8D 04 D4 C0 07 D0 02 C1
C4A8: A0 00 AD 00 DC 29 10 D0 DD
C4B0: B1 84 FC B9 44 03 F0 16 EB
C4B8: A9 81 8D 04 D4 A9 05 8D 86
C4C0: 01 D4 20 E5 C7 20 11 C8 5E
C4C8: 20 48 C8 4C 5A C5 A9 21 31
C4D0: 8D 04 D4 A9 05 8D 01 D4 49
C4D8: 20 D2 C2 18 69 06 C9 F0 D0
C4E0: 90 F3 A9 20 20 8C C6 EA 8D
C4E8: EA EA A9 F8 8D 06 D4 A2 6C
C4F0: 00 86 FD A2 11 8E 04 D4 90
C4F8: CA 8E 04 D4 20 81 C6 20 B3
C500: 81 C6 20 81 C6 20 81 C6 19
C508: A6 FD E8 E0 05 90 E2 78 67
C510: F8 18 AD 3C 03 6D 42 03 C0
C518: 8D 3C 03 AD 3D 03 6D 43 83
C520: 03 8D 3D 03 AD 3E 03 69 49
C528: 00 8D 3E 03 18 AD 3C 03 FB
C530: 69 50 8D 3C 03 AD 3D 03 A4
C538: 69 02 8D 3D 03 AD 3E 03 60
C540: 69 00 8D 3E 03 AD 3F 03 68
C548: 69 01 8D 3F 03 D8 58 A9 5D
C550: 00 8D 42 03 8D 43 03 4C 43
C558: A7 C5 78 F8 38 AD 40 03 60
C560: E9 01 8D 40 03 D8 58 A9 F6
C568: 20 8D 04 D4 A9 F8 8D 06 25
C570: D4 A2 00 BD 44 03 F0 04 E1
C578: E8 4C 73 C5 86 FD A2 00 0E
C580: 86 FE A9 FE A6 FD 9D F8 E9
C588: 07 A9 21 8D 04 D4 20 D2 B3
C590: C2 A9 20 8D 04 D4 A6 FD 28
C598: A9 FF 9D F8 07 20 D2 C2 95
C5A0: A6 FE E8 E0 24 D0 D9 A9 88
C5A8: 00 8D 18 D4 8D 15 D0 A2 39
C5B0: 00 BD 2D C6 20 D2 FF E8 3E
C5B8: E0 30 D0 F5 A2 03 A0 07 DD
C5C0: 18 20 F0 FF A2 02 BD 3C 88
C5C8: 03 4A 4A 4A 4A 18 69 30 A6
C5D0: 20 D2 FF BD 3C 03 29 0F F8
C5D8: 18 69 30 20 D2 FF CA E0 29
C5E0: FF D0 E3 A2 05 A0 13 18 09
C5E8: 20 F0 FF AD 40 03 4A 4A 7F
C5F0: 4A 4A 18 69 30 20 D2 FF 2A
C5F8: AD 40 03 29 0F 18 69 30 D3
C600: 20 D2 FF A2 07 A0 0F 18 64
```

IMPORTANT! Letters on white background are **Bug Repellent** line codes. **Do not enter them!** Pages 83 and 84 explain these codes and provide other essential information on entering ***Ahoy!*** programs. Refer to these pages **before** entering any programs!

```
C608: 20 F0 FF AD 3F 03 4A 4A 9D
C610: 4A 4A 18 69 30 20 D2 FF 49
C618: AD 3F 03 29 0F 18 69 30 F1
C620: 20 D2 FF 60 99 F8 07 20 2D
C628: 81 C6 A4 FC 60 93 05 0D 18
C630: 0D 0D 53 43 4F 52 45 3A 02
C638: 0D 0D 43 48 41 4E 43 45 F5
C640: 53 20 52 45 4D 41 49 4E 71
C648: 49 4E 47 3A 0D 0D 43 55 14
C650: 52 52 45 4E 54 20 4C 45 8E
C658: 56 45 4C 3A 0D 20 03 C0 6B
C660: 20 E8 C1 20 28 C4 20 5C B4
C668: C1 20 32 C2 20 D2 C2 20 15
C670: D2 C2 20 06 C3 20 D2 C2 A5
C678: 20 D2 C2 20 50 C4 4C 92 42
C680: C6 A2 40 A0 00 88 D0 FD 22
C688: CA D0 FA 60 8D 04 D4 4C 32
C690: D2 C2 AD 40 03 F0 1F A2 C9
C698: 18 A0 05 18 20 F0 FF A2 22
C6A0: 00 BD 26 C7 20 D2 FF E8 28
C6A8: E0 1D D0 F5 AD 00 DC 29 21
C6B0: 10 D0 F9 4C 60 C6 AD 3E EA
C6B8: 03 CD 4E 03 90 2A F0 02 88
C6C0: B0 14 AD 3D 03 CD 4D 03 91
C6C8: 90 1E F0 02 B0 08 AD 3C 0D
C6D0: 03 CD 4D 03 90 12 AD 3C 7E
C6D8: 03 8D 4C 03 AD 3D 03 8D 34
C6E0: 4D 03 AD 3E 03 8D 4E 03 FE
C6E8: A2 00 BD 43 C7 20 D2 FF 47
C6F0: E8 E0 34 D0 F5 A2 0B A0 04
C6F8: 0C 18 20 F0 FF A2 02 BD 90
C700: 4C 03 4A 4A 4A 4A 18 69 F9
C708: 30 20 D2 FF BD 4C 03 29 61
C710: 0F 18 69 30 20 D2 FF CA 8E
C718: E0 FF D0 E3 AD 00 DC 29 61
C720: 10 D0 F9 4C 82 C7 50 52 34
C728: 45 53 53 20 46 49 52 45 5B
C730: 42 55 54 54 4F 4E 20 54 82
C738: 4F 20 54 52 59 20 41 47 50
C740: 41 49 4E 0D 0D 47 41 4D 09
C748: 45 2D 4F 56 45 52 0D 0D 12
C750: 48 49 47 48 20 53 43 4F 77
C758: 52 45 3A 0D 0D 50 52 45 2C
C760: 53 53 20 46 49 52 45 42 90
C768: 55 54 54 4F 4E 20 54 4F C7
C770: 20 53 54 41 52 54 0D A9 D6
C778: 00 8D 4C 03 8D 4D 03 8D C0
C780: 4E 03 AD 00 DC 29 10 F0 86
C788: F9 4C D6 C7 00 00 00 00 6D
C790: 00 00 00 00 00 00 0C 00 9C
C798: 00 E2 C0 03 1C 90 01 BB A8
C7A0: 60 0D DD 98 26 3A CE 1D D0
C7A8: DD 9A 3A 88 76 07 77 A0 79
C7B0: 0A E1 D0 0E 6E A0 01 DB 67
C7B8: 40 03 76 C0 00 4D 00 00 80
C7C0: E6 00 00 1C 00 00 24 00 E7
C7C8: 00 3C 00 00 AE 26 D0 E8 93
C7D0: 8E 26 D0 4C 31 EA 78 A9 E0
C7D8: CC 8D 14 03 A9 C7 8D 15 5E
C7E0: 03 58 4C 5D C6 A9 77 8D 5B
C7E8: 0F D0 A6 FC E8 A9 14 18 2B
C7F0: 69 1E CA D0 FA 8D 0E D0 7B
C7F8: A9 FC 8D FF 07 A2 00 8A 61
C800: 9D 00 3F E8 E0 40 D0 F8 B0
C808: A9 FF 8D 1C D0 8D 15 D0 9F
C810: 60 A0 14 A9 05 84 02 85 DF
C818: FF 98 18 65 02 65 02 A8 40
C820: B9 8C C7 99 00 3F B9 8D 4E
C828: C7 99 01 3F B9 8E C7 99 73
C830: 02 3F 20 D2 C2 20 D2 C2 DC
C838: A4 02 88 A5 FF 8D 01 D4 70
C840: 18 69 05 C0 FF D0 CE 60 87
C848: A0 00 A5 FF 84 02 85 FF 9A
C850: 98 18 65 02 65 02 A8 A9 22
C858: 00 99 00 3F 99 01 3F 99 A4
C860: 02 3F 20 D2 C2 20 D2 C2 0D
C868: A4 02 C8 A5 FF 8D 01 D4 E0
C870: 38 E9 05 C0 15 D0 D5 60 74
C878: 00 78
```

TRACKDOWN
FROM PAGE 80

C-64 VERSION

```
·10 REM *** TRACKDOWN (64) *** BUCK CHILD
 RESS (11/07/85) ***                      LM
·20 REM *** P.O. BOX 13575 SALEM, OR 9730
 9 ***                                    DC
·30 PRINTCHR$(147)"LOADING AND CHECKING D
 ATA.":PRINT                              BG
·40 FORJ=53000TO53157:READA:POKEJ,A:X=X+A
 :NEXTJ                                   GO
·50 IFX<>24385THENPRINT"ERROR IN DATA.":E
 ND                                       FC
·60 PRINT"DATA OK.":PRINT:PRINT"SYS 53[3"
 0"] TO ACTIVATE.":END                    BO
·70 DATA162,0,172,1,8,200,200,132,253,169
 ,8,133                                   PF
·80 DATA254,161,253,141,166,207,230,253,1
 61,253,141,167                           GC
·90 DATA207,230,253,169,5,141,168,207,169
 ,8,133,252                               FD
·100 DATA162,0,173,168,207,133,251,173,16
 8,207,197,251                            OM
·110 DATA208,22,201,6,240,18,161,251,201,
 34,240,4                                 AH
·120 DATA201,35,208,8,169,6,141,168,207,7
 6,44,207                                 OG
·130 DATA161,253,240,7,193,251,240,39,76,
 153,207,161                              ML
·140 DATA251,240,44,32,159,207,32,159,207
```

```
,161,253,240                                NB
·150 DATA60,32,159,207,161,253,141,166,20
7,32,159,207                                FH
·160 DATA161,253,141,167,207,32,159,207,7
6,44,207,230                                AA
·170 DATA251,161,251,240,6,32,159,207,76,
51,207,174                                  NF
·180 DATA166,207,173,167,207,32,205,189,1
69,13,32,210                                BP
·190 DATA255,32,159,207,76,44,207,230,253
,208,2,230,254,96                           BC
```

VIC 20 Bug Repellent required for proofreading. See April '86 *Ahoy!* or any previous issue.

VIC 20 VERSION

```
·10 REM *** TRACKDOWN (VIC-20) *** BUCK C
HILDRESS (11/07/85) ***                     KE
·20 REM *** P.O. BOX 13575 SALEM, OR 9730
9 ***                                       HH
·30 POKE55,76:POKE56,29:CLR                 JK
·40 PRINTCHR$(147)"LOADING AND":PRINT"CHE
CKING DATA.":PRINT                          BJ
·50 FORJ=7500TO7657:READA:POKEJ,A:X=X+A:N
EXTJ                                        NJ
·60 IFX<>22021THENPRINT"ERROR IN DATA.":E
ND                                          IA
·70 PRINT"DATA OK.":PRINT:PRINT"SYS 7500
TO ACTIVATE.":END                           MP
·80 DATA162,0,172,1,16,200,200,132,253,16
9,16,133                                    PK
·90 DATA254,161,253,141,234,29,230,253,16
1,253,141,235                               DI
·100 DATA29,230,253,169,5,141,236,29,169,
16,133,252                                  FC
·110 DATA162,0,173,236,29,133,251,173,236
,29,197,251                                 LJ
·120 DATA208,22,201,6,240,18,161,251,201,
34,240,4                                    AH
·130 DATA201,35,208,8,169,6,141,236,29,76
,112,29                                     NN
·140 DATA161,253,240,7,193,251,240,39,76,
221,29,161                                  MJ
·150 DATA251,240,44,32,227,29,32,227,29,1
61,253,240                                  JI
·160 DATA60,32,227,29,161,253,141,234,29,
32,227,29                                   BP
·170 DATA161,253,141,235,29,32,227,29,76,
112,29,230                                  AJ
·180 DATA251,161,251,240,6,32,227,29,76,1
19,29,174                                   HH
·190 DATA234,29,173,235,29,32,205,221,169
,13,32,210                                  MF
·200 DATA255,32,227,29,76,112,29,230,253,
208,2,230,254,96                            PA
```

SCUTTLEBUTT

Continued from page 14

fuel pump problems actual pilots faced while diving. Both simulator and game scenarios are provided, the latter giving any number of players a chance to shoot down enemy aircraft. Number of kills and flight hours are recorded on a separate disk so that succeeding flights can become tougher.

Macbeth ($25.00) consists of separate text adventures covering four stages of Shakespeare's play, from the young Macbeth's attempt to suppress the rebels in the service of his king to the desperation of the tyrant trapped in his fiery castle. In between, you'll help the three witches concoct their evil brew and, as Lady Macbeth, determine how to murder the king in his bed. Each stage is accompanied by a psychological program in which you try to determine what motivated the characters' murderous acts.

Mission on Thunderhead ($25.00), a futuristic bivouac with over 50 rooms and 4 mazes, contains two scenarios: Operation Tempest (find the device needed to destroy the complex and free the human race) and The Final Appeal (a planetwide scavenger hunt to find the necessary objects to open the Freedom Gate).

Previously available on Atari, *Gulf Strike* places you in far-off 1987, following a Russian invasion of Iran. As the U.S. commander, you must direct a multinational force to repel the invasion; or, as the Soviet commander, use your momentum to capture the oil fields in northern Iran before the American army and airpower push you back. Featured are air strikes, ranger drops, anti-sub warefare, and solitaire and two-player modes.

The Avalon Hill Game Company, Microcomputer Games Division, 301-254-9200 or 800-638-9292 (see address list, page 82).

First called Diablotin in Europe, where it was invented over 50 years ago, *Diablo* for the Amiga involves moving a ball along 232 sections of constantly shifting tracks arranged on 116 moving panels. Price is under $50.

Classic Image Inc., 201-389-3633 (see address list, page 82).

...COMING IN THE JULY ISSUE OF *AHOY!* (ON SALE JUNE 3)...

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161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300

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